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THERAPEUTIC RADIOLOGY AS A SPECIALTY*

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WHEN the similarity of the physical and biologic effects of roentgen rays and radium had been demonstrated, some physicians employing roentgen rays in treatment acquired radium and used it for superficial lesions. According to O'Brien,[5] Alexander Graham Bell first suggested the possibility of using radium interstitially, and Dr. Margaret Cleaves of New York was the first to use it for cancer of the cervix in 1903. These methods of using radium required surgical ability possessed by few roentgenologists, therefore some of them loaned their radium to surgical colleagues and instructed them in its use. It seems likely that this generosity and also the lack of surgical ability of roentgenologists established a precedent which still exists for the use of radium by surgeons and by few radiologists.

To alter this situation we must overcome complacency, correct our astigmatic perception of the present status of therapy in this country, visualize future possibilities and develop therapeutic radiology in all of its phases as a specialty in medicine.

Therapeutic radiology in its broadest sense may be defined as the use of roentgen rays, radium and artificial radioactive materials in treatment. There can be little doubt that diagnostic roentgenology and therapeutic radiology have developed, will proceed and progress along increasingly divergent pathways. Already investigations with artificial radioactive materials useful in medical practice have revealed new vistas to radiotherapists. We must be prepared to utilize similar developments which may be anticipated.

We must recognize and accept the fact that there is nothing in common between diagnostic and therapeutic radiology except the use of roentgen rays. The rays for each are produced by different types of apparatus, however; roentgen therapy is only one phase of therapeutic radiology. Diagnostic roentgenology also has become increasingly complex. There are many types of apparatus and techniques necessary for making special examinations which require great proficiency to interpret. Therapeutic radiology requires knowledge of physical and biologic effects of ionizing radiations, of pathology, surgical procedures and clinical medicine which is neither necessary nor applicable in diagnostic roentgenology. As a matter of fact, diagnostic roentgenology is of no more impor-

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tance to a radiotherapist than to any other physician as an aid in establishing correct diagnosis.

It is possible for a diagnostic roentgenologist in a large, busy department never actually to see patients and only to examine them by the dim light of the fluoroscopic screen or shadows of parts of their anatomy photographed on films. In fact, patients frequently do not realize that a physician and not a technician is conducting these examinations. In contrast, the therapeutic radiologist is in close personal contact with patients during their examination and treatment in the department, in the operating room, at the bedside and for periods of observation, unfortunately in some instances not long enough. As Newell[4] put it, "The diagnostic roentgenologist practices little of the art of medicine." I may add that the therapeutic radiologist must be a physicist, pathologist, clinician and surgeon to practice his art of medicine.

In view of the vast differences in diagnostic and therapeutic radiology it should be obvious that separation of these branches is advisable, and should be initiated in large teaching institutions in this country as soon as possible to improve the status of both. This separation has been successfully accomplished in Britain, Sweden and other countries. In commenting on this subject ten years ago Forssell[1] said: "Roentgen diagnosis and radiotherapy, and the investigation of each belong . . . to different spheres of medicine . . . a complete divorce between roentgen diagnosis and radiotherapy confers such great advantages both for research work and instruction, as well as utilization of radiology in practical medicine, that I consider one of radiology's highest hopes to be division as soon as possible of radiological work."

The first step in this direction must be taken by conscientious directors of departments of radiology, most of whom are recognized primarily as diagnostic roentgenologists. To many of them therapeutic radiology is a stepchild which they have accepted of necessity but are too preoccupied to foster. In my opinion few, if any, are capable of practicing or teaching all phases of therapeutic radiology as previously defined. They should recognize the limitations, relinquish part of their monopolies and encourage development of departments of therapeutic radiology in their institutions. This will necessitate separation of administration. I do not agree with those[3] who believe that one individual should, or is capable of directing a department of radiology including both diagnosis and therapy according to modern standards or those which we anticipate. There are so many reasons why this is undesirable and opposed to the best interests of the science of radiology or the welfare of patients that I shall not attempt to enumerate them but will quote again from Forssell[1] whom we admire as an able administrator. He said, "From a mere practical point of view . . . it is impossible for one and the same man to satisfactorily direct both roentgen diagnostic work and radiotherapy of a large hospital, if he is not a genius."

For one individual, whether a diagnostic or therapeutic radiologist, to devote the time necessary to the regulation of a large department of radiology comprising two widely different activities is a waste of medical talent. This skill might be utilized more advantageously in examination or treatment of patients. Also, either a diagnostic roentgenologist or therapist is more familiar with the requirements of his branch and therefore more capable of directing and teaching it than a person whose interests are necessarily divided, and whose inclinations would be radiologically unilateral. For these reasons, present heads of departments of radiology in institutions where separations have not been made should select and appoint therapeutic radiologists to direct and be responsible for their own departments.

Let me call attention to certain situations in regard to the practice and teaching of therapeutic radiology which exist in this country. In certain hospitals the so-called departments of radiology practice princi-

pally diagnostic roentgenology and roentgen therapy but have nothing to do with radium therapy. In not a few teaching institutions the department of radiology nominally controls radium in the sense that it is stored in the department and dosages calculated as an academic exercise principally for the benefit of non-radiologists who apply it, but the trainees in radiology gain little if any personal experience in its practical usages. Few of these non-radiologists teach radium therapy to trainees in radiology but do instruct other non-radiologists. I have heard of one teaching institution where trainees in radiology calculate radium dosages for exercise but are not permitted in the operating room when it is applied surgically. There are institutions where radium is used only by surgeons who also write prescriptions for roentgen therapy which technicians follow when administering it. I have heard of an institution where members of the staff wanted to use radioactive isotope therapy but when the head of the department of radiology was asked to take part in the project and supervise it, he refused. There are many places where heads of departments of radiology or assistants plan courses of roentgen therapy but technicians administer it and patients are seen by doctors only occasionally. This also is customary in private offices. It seems to me that such practices as these are not good therapeutic radiology but can be corrected and standards and teaching of the science improved by division of diagnosis and therapy into separate branches.

What I have said applies principally to teaching institutions. We all realize that in this large country, populated widely and thinly in some areas, we must have what I have called "general practitioners of radiology."[7] Holmes[2] recognized our need for general practitioners and specialists, and stated, "At least two types of men are necessary, each possibly requiring somewhat different training. First, there is that great group of roentgenologists who carry on the bulk of routine work in our smaller hospitals and in general practice. Second, there are those men, leaders in our specialty, who are to do the teaching and research work."

Although general practitioners of radiology render invaluable services they also must recognize their limitations and realize that it will be advantageous to have specialists in both diagnostic roentgenology and therapeutic radiology on whom they can rely for instruction, consultation and assistance. Surgery and internal medicine have been divided into many specialities, principally because specialists render the best service to patients and are more proficient in teaching. Although general practitioners of radiology have contributed much to the science in the past, the outstanding advances in medicine have been made by specialists with facilities for research and broad experience with large groups of patients. Likewise, the science of radiology can make most rapid progress, and maintain itself as an independent branch of medicine by specialization.

Examiners in therapy for the American Board of Radiology have been concerned about the obvious inadequacy of training accorded candidates, especially in radium therapy. Most candidates have theoretical knowledge of therapy acquired from reading, but few have had opportunity for personal experience in treating patients and observing long time results. Many have not had more than nine months of instruction in therapy which is not time enough to learn more than some fundamentals of physics and techniques and is insufficient for clinical application or experience.

In addition to separating diagnostic roentgenology and therapeutic radiology in teaching institutions, it will be necessary to change our instructional programs. Quick[8] probably had this in mind when he said, "With the ideal of better and more complete service ever before us, and supported by the demands of constituted authorities in our field, progress in the training and practice of therapeutic radiology will be accomplished."

The development of separate departments of therapeutic radiology, especially in universities, will not be easy. Pendergrass[6] when speaking on "Radiology in the Medical School" emphasized this when he said, "One of the chief difficulties of achieving such an opportunity in our medical schools for the young teacher and investigator is an adequate budget. . . . It is altogether likely that many of the administrative heads of teaching hospitals will not be tempted to participate in the budget necessary to carry on radiologic activities in medical schools. There are some that will. They must show the way." It seems to me that heads of departments of radiology must be the first to show the way. They should convince themselves and administrative heads of institutions that the best possible facilities of therapeutic radiology must be provided for patients and students and that this can be done best by specialists adequately trained and experienced in all phases of radiation therapy. When a few are persuaded and lead, many will follow.

The principal reason why therapeutic radiology has not developed as a specialty in this country reverts to the time when roentgenologists lacking surgical experience relinquished radium therapy to non-radiologists; since then little effort has been made to alter the situation by training radiologists in surgical uses of radium. We now are confronted with a similar situation in regard to artificial radioactive materials, the medical uses of which may be lost to radiology unless active steps are taken to incorporate teaching of this subject and actual use of these materials in departments of therapeutic radiology. We must en courage young physicians to study therapeutic radiology in this and all other phases and provide adequate training for them. Undoubtedly it will be necessary to persuade non-radiologists to participate in the teaching program.

I suggest that teaching institutions organize special instructional courses in therapeutic radiology based somewhat on the following plan as minimal requirements.

First, a rotating internship after graduation from medicine.

Second, six months devoted exclusively to pathology.

Third, six months devoted exclusively to study of radiologic physics, including roentgen rays, radium and artificial radioactivity.

Fourth, one year's instruction in surgery and operative techniques.

Fifth, two years of clinical training and experience in all phases of therapeutic radiology.

This program would require four years of special instruction after internship. This may seem to be an ambitious undertaking but I believe it, or a similar plan, could be established in many teaching institutions. If it is done, therapeutic radiology will soon be recognized as a specialty in medicine, the status of the science of radiology will be improved and patients will receive better treatment.

In conclusion, I will state that in my opinion, first, division of radiology into separate specialties of diagnostic roentgenology and therapeutic radiology is desirable and must be accomplished as soon as possible in this country. Second, that the first step in this direction must be made by heads of departments of radiology in teaching institutions. Third, that special courses of instruction should be arranged for training in therapeutic radiology. Fourth, that we strive to attain the ideal of therapeutic radiology as an independent specialty in medicine.

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PLANNING THE RADIOISOTOPE PROGRAM IN THE HOSPITAL*

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AS MORE information becomes available about the use of radioisotopes in medical diagnosis, therapy, and research, more physicians become interested in using them. The Atomic Energy Commission has published various pamphlets which are helpful in starting a radioisotope program in a hospital, but nowhere has a general plan been presented. It should be useful to summarize this information, together with some approximate data regarding cost of equipment.

Because of the potential health hazards connected with radioactivity, the Atomic Energy Commission has set up certain criteria for the allocation of radioactive substances to be used in humans. The Subcommittee on Human Applications has stated three general aims governing the distribution of isotopes for medical purposes. They are:

1. To make radioisotopes available for diagnostic and therapeutic purposes where they are needed and can be handled safely and properly.

2. To protect, as far as possible, patients from indiscriminate use of radioisotopes.

3. To insure that adequate facilities are available for those planning to use these materials.

Accordingly they have established the following criteria based upon these aims: (Ref. Isotopes Division Circular D-4)

1. Physicians using radioactive material must be associated with a medical research institution, hospital, clinic, or other medical organization possessing adequate facilities, and which is in good standing with the local medical society. Facilities must be adequate for:
   a. Clinical care of the patient.
   b. Assaying, safe handling, and disposal of radioactive materials.
2. The hospital or medical institution should appoint a local "Isotope Committee" to evaluate all proposals for medical use of the substances within that institution. This Committee should include:
   a. A physician trained in internal medicine.
   b. A physician trained in hematology.
   c. An individual experienced in assay of radio-materials, and in protection of personnel against ionizing radiations.
   d. Whenever possible, a qualified physicist and a therapeutic radiologist. (If these are not members of the committee, they should be available as consultants.)
3. The scientifically trained individual who will use or directly supervise the use of the material must be an accredited physician in good standing with the local medical society.
4. This physician must have had previous clinical experience with radiation or radioactive materials, or be directly collaborating with an individual possessing such training and experience.

Furthermore, the Subcommittee has established a general policy that isotopes of half-life greater than thirty days will not be made available for internal use with humans unless extensive prior studies have been made on animals. Some exceptions to this policy may be made, but they would probably not be requested by a group initiating its program.

The group wishing to commence work with radioactive isotopes in an institution which has not previously requested approval for receipt of these materials often faces a sort of dilemma. They do not want to establish a laboratory until they are sure

* Presented at the Thirty-first Annual Meeting, American Radium Society, Atlantic City, N. J., June 5–7, 1949.

they can get the isotopes. On the other hand, they will not be approved for isotope use until they have a satisfactory set-up. However, it may be said that no reasonable application by properly qualified individuals will be refused. If there is doubt as to the applicability of a plan, clarification can usually be obtained through personal correspondence with the Isotopes Division, consulting or cooperating physicist should not be expected to make many routine measurements.

In deciding upon space and equipment, some help can be obtained from reprints and pamphlets available from Oak Ridge on request. These include price lists of radiation instruments, instructions for handling radioactive material, general plans of

TABLE I

COMPARISON OF RADIOISOTOPES

	Half-life	Beta Radiation				Gamma Radiation			
		Maximum energy mev.	Completely stopped by Water mm.	Pyrex mm.	Air cm.	Energy mev.	r/mc. hr. at 1 cm.	"Danger range" for 1 mc.	Half-value layer cm. Pb
$_{6}C^{14}$	5100 years	0.15	0.2	0.1	16		None		
$_{11}Na^{24}$	14.8 hours	1.4	6.4	2.8	500	1.4 2.8	19.1	55.3 cm. or 21.8 in.	1.7
$_{15}P^{32}$	14.3 days	1.7	8.0	3.5	620		None		
$_{16}S^{35}$	87 days	0.17	0.2	0.1	16		None		
$_{27}Co^{60}$	5.3 years	0.31	0.8	0.4	62	1.1 1.3	13.6	46.6 cm. or 18.4 in.	1.4
$_{53}I^{131}$	8 days	0.60	2.0	1.0	160	0.080 0.367	2.65	20.6 cm. or 8.1 in.	0.28

Note: The "danger range" is the distance at which the dosage rate is 6.25 mr./hour (or 0.3 r/week for 48 hours weekly exposure).

Atomic Energy Commission, Oak Ridge, Tennessee.

The first step, therefore, must be the establishment of the local Isotope Committee, with the type of membership just outlined. These men should consider the immediate and probable future isotope needs, and provide for suitable laboratory space for handling and processing the isotopes as they are received from Oak Ridge, and for the measurements of radioactivity at various levels, both in patients, and in excreta and tissue specimens. At least the minimum necessary apparatus should be acquired, and a technician trained in its use. The laboratory layouts, discussions of radiation protection, lists of physical and chemical consultants, and bibliographies for work with various isotopes.

LABORATORY FACILITIES AND EQUIPMENT

The radiation and contamination hazards may be materially reduced by adequate and suitable laboratory space, efficient equipment for the handling and measuring of the isotopes and, most of all, the rigid adherence to safe operating techniques.

The space requirements vary widely with the types and amounts of isotopes

used, the usual minimum being three rooms: (1) The "hot laboratory" equipped for the handling and preparation of fairly large quantities of isotopes, up to several hundred millicuries. (2) A measuring room for the determination of low-level specimens and possibly also for the uptake measurements on patients. (3) A small storage room for radioactive materials.

The equipment and facilities of the "hot laboratory" will also vary greatly with the type and quantity of isotopes used. It is advisable at least to provide space for a chemical hood designed especially for the handling of isotopes. The hood may not be required initially, if only rather small amounts of isotopes are used and there is no drying of active materials.

The hood should first of all provide adequate shielding against beta radiation (see Table 1). It is not always practical to provide sufficient shielding of the hood to give complete gamma-ray protection as that may require lead lining several inches thick for such isotopes as Na^{24}. Instead, barriers of lead bricks may be placed around each radioactive source; the shielding of the hood then serves mainly to absorb the scattered radiation, which is much more readily attenuated due to its lower energy.

A typical hood for hospital isotope work is shown schematically in Figure 1. It will be noted that the two sliding panels provide

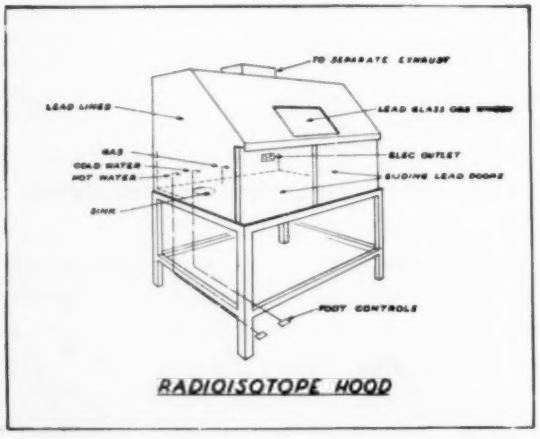

FIG. 1. Schematic drawing of satisfactory hood for radioisotope work.

openings for the hands and at the same time double the shielding thickness in front of the technician when it is needed the most. It should be emphasized here that the hospital shielding requirements are considerably less than those used on most Atomic Energy Commission projects where many curies may be handled. On the other hand, the better the shielding of the hood, the less the dependence on proper arrangement of the movable barriers. Frequently too little consideration is given to the protection of people on the other side of the wall near the hood or storage space, and this may be quite transparent to the type of gamma radiation present. Considerable shielding economy may be gained by placeing the hood against a wall which has no occupancy on the other side. For example, against an outside wall usually no shielding is required.

Where feasible, provisions should be made for the remote handling of radioactive materials. Effective manipulators have been devised, but such elaborate equipment would be necessary only where large gamma emitting sources are handled rou tinely. Simpler devices would suffice in most hospital isotope laboratories. Where possible, sufficient shielding should be provided to stop all the beta radiation at the source. The thicknesses required are indicated in Table 1 for the more commonly used isotopes.

When handling isotopes which are beta emitters only, the main problem is to prevent contamination. In Figure 2 is shown the "glove box" which permits carrying out experiments without actual contact with apparatus which may be contaminated, and which provides protection against soft beta emitters such as C^{14} and S^{35}.

In addition to the hood, the "hot laboratory" should have a special chemical laboratory bench provided with the usual facilities such as a sink, gas, air, and electric outlets. This bench should have a stainless steel top with raised edges, to prevent overflow and contamination of the worker in case of spills. The same end may

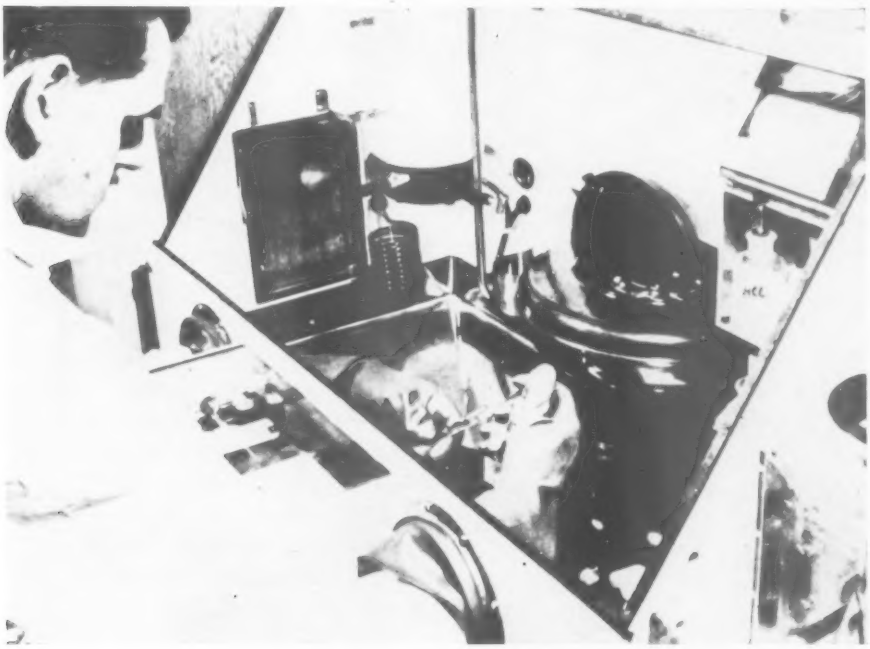

Fig. 2. "Glove box" for carrying out certain manipulations with isotopes without danger of contamination.

be achieved by keeping all equipment on stainless steel trays during use.

All exposed surfaces of the "hot laboratory" should be smooth and non-porous. Uncovered wooden and concrete floors are not desirable. Linoleum and rubber tile offer satisfactory floor covering as they can readily be replaced in case of serious contamination. Strippable paint should be used on wall surfaces likely to become contaminated, as it can readily be peeled off.

In the planning of new hospitals the question comes up where to place the "hot laboratory." A top floor location has the advantage of simplifying the exhaust of the hood, which cannot be connected to the general hospital ventilating system. On the other hand, a basement, or ground floor location permits the drain of the sinks to be connected directly to the main soil line of the hospital, thereby eliminating contamination of the local plumbing. A one story building would satisfy both requirements, but this is, of course, not generally possible. Other considerations, such as nearness to the departments most closely associated with the isotope program may be the deciding factor.

The occupancy of the "hot laboratory" should be restricted to that actually required in conjunction with the isotope work, in order to minimize the exposure of the personnel. This may be encouraged by limiting other equipment and furniture to a minimum.

The thickness of lead needed to reduce the gamma radiation to the permissible level of 6.25 mr/hr. may be calculated from the "danger range" and the half-value layer.* If the distance is less than the "danger range" the attenuation factor required by the shielding may be determined from the ratio:

$$\frac{(\text{danger range for 1 mc.})^2 \times \text{millicuries}}{\text{distance}^2}.$$

The thickness of lead may then be determined, knowing that 1 half-value layer gives an attenuation factor of two, 2 half-

* The "danger range" is the distance from a radioactive source at which its gamma radiation is reduced to 6.25 mr/hour, which corresponds to 0.3 r/week (the present permissible dose), assuming 48 hours' exposure per week.

value layers of four, 3 half-value layers of eight, and so forth. For instance, suppose lead shielding has to be provided for 100 mc. of I^{131} and the distance to the person is 100 cm.·

Attenuation Factor

$$\frac{20.6 \times 20.6 \times 100}{100 \times 100} = 4.25$$

or slightly more than 2 half-value layers. This requires 0.6 cm. ($\frac{1}{4}$ in.) of lead. For 100 mc. of Na^{24} with a danger range of 55.3 cm., the lead thickness would be $3\frac{1}{4}$ in.

A special *storage space* should be provided for the radioactive materials, including excretions where these are allowed to decay before discharge into the sewerage system. The storage space should be near the "hot laboratory" but distant from the measuring room. If possible it should be shielded with concrete or brick walls, thereby reducing the need for individual lead shielding. It should preferably be provided with a sink with a drain connected directly into the main soil line of the hospital, thereby reducing contamination of the local plumbing. At the new Delafield Hospital both the "hot laboratory" and the storage room are located in the sub-basement and the measuring rooms are on the floor above. A special dumb waiter is provided for the transfer of the isotopes. On the way to the upper floor the sample passes through the center of a large ionization chamber where it can be stopped for gamma-ray measurements of its activity.

The *measuring room* should be located distantly from intense sources of radiation such as roentgen therapy equipment and large amounts of gamma emitting materials. The room should be equipped with tables for the measuring equipment, including ionization instruments and scalers with Geiger counters mounted in heavy lead shields. Several A.C. electric outlets and a sink should be provided, but no other facilities are required. If possible, uptake measurements on patients should be made in a separate room but where this is not feasible, the measuring room should be accessible to both out- and in-patients, including stretcher cases.

SHOWER AND DRESSING ROOM FACILITIES

Most industrial plants handling radioactive materials have provisions for the workers to take showers and change clothes before leaving the premises. Similar facilities have been advocated for hospital isotope laboratories by physicists with AEC background. However, the possibility of general body contamination is remote in the well supervised hospital isotope laboratory. It is, therefore, the opinion of the authors that ordinary dressing room facilities are all that is necessary for such laboratories. Stress should be put on preventing contamination rather than clearing it up afterwards.

COST OF SETTING UP AN ISOTOPE LABORATORY

Without being extravagant it is possible to spend more than $50,000 to provide a laboratory which is equipped to handle most isotopes of medical usefulness. However, if the institution is willing to limit its initial use to those isotopes of widest application, such as I^{131} and P^{32}, the cost may be less than $6,000. The biggest items would be the hood and plumbing facilities. The hood may be obtained without lead lining and lead bricks may be used in its place until the work increases sufficiently to justify complete shielding. The measuring instruments should include at least two Geiger counters, one arranged for uptake measurements on patients and the other mounted in a shield for measurements of samples. An ionization chamber may be used to advantage in the determination of larger amounts (100 μc. or more) of gamma emitting isotopes. In addition, certain survey instruments must be provided for area and personnel monitoring. The total cost of all these instruments would be of the order of $2,500.

About $500 must be assigned to auxiliary equipment such as lead blocks, glassware,

pippettors, forceps, tongs and other laboratory equipment.

WASTE DISPOSAL

The proper provision for the disposal of radioactive wastes may be considered briefly. These wastes may be tissues or specimens from experimental animals, or excreta, operating room or autopsy specimens from patients. They may result from tracer or therapeutic administration of the materials. In general, at the levels used in hospitals, direct disposal into sewer or incinerator system is permissible. A committee is working on the formulation of rules for all isotopes; in the meantime, interim recommendations for iodine and phosphorus, the two most commonly used, have been set as follows: (Ref. Isotopes Division Circular B-6)

Radioiodine: This may be discharged into the main sewer, provided the daily volume of water flowing from the sewage outlet of the institution to the main sewer is sufficient to dilute the radioiodine to 0.5 microcurie per liter, and that the maximum disposed of from any one institution will not exceed 200 millicuries per week;

or

provided that to each millicurie of iodine discharged, one gram of potassium iodide is added at the time of disposal, and that the daily average volume of water flowing to the main sewer is sufficient to dilute the radioiodine to 10 microcuries per liter.

Radiophosphorus: This may be discharged directly into the main sewer, provided that the daily volume of water flowing from the sewage outlet of the institution to the main sewer is sufficient to dilute the radiophosphorus to 0.1 microcurie per liter, and that each millicurie is diluted with 10 grams of phosphorus as phosphate at the time of discharge. (In the usual sanitary sewer system more than this amount of phosphate occurs naturally.) The sewage must not enter directly into a fresh water system. The Isotope Committee must assure itself that these conditions are met in its institution.

APPLICATION FOR ISOTOPE USE

When the laboratory provisions have been made, the Isotopes Committee or the responsible investigator is ready to send a request to the Oak Ridge National Laboratory, for application blanks for radioisotope procurement. The form AEC-313 will be sent and must be filled out carefully and completely. A detailed instruction sheet will accompany the blank; it is well to follow this closely; it is better to err in giving too much information than not enough. If space on the blank is not sufficient, attach extra pages. This is all the Subcommittee on Human Applications has as a basis for accepting or rejecting the application. Particular care should be given to the statement of the proposed plan of study, types of patients to be used, proposed dosages, repetition of dose and such relevant details.

With the completely filled-out form AEC-313 must go a letter from the local Radioisotope Committee, stating its approval of the project.

The application, with any attached documents, is copied and sent to the members of the Subcommittee on Human Applications each one of whom approves, rejects, or asks for additional information. The members of the committee make every effort to expedite the applications; delays can be avoided by careful and complete preparation of the blank.

At the time the application is filed, or at least before any allocation of isotopes can be made, it is also necessary to submit three copies of a form entitled "Acceptance of terms and conditions for order and receipt of radioactive by-product materials." This contract must be completed and signed by an official in the institution who is authorized to sign such undertakings. It is a three page document containing 15 items, whose essence is that the applicant agrees to accept responsibility for the isotopes and their containers, undertakes not

to turn over any of the material for use by anyone not covered by the contract, promises to keep adequate records concerning receipt, storage, use and disposal of isotopes, permits the Atomic Energy Commission to inspect all isotope facilities and records, and declares the institution financially responsible.

When the application has been accepted and the contract filed, a new form AEC-374, an authorization for isotope procurement, is sent to the applicant, together with three copies of a "Certificate of compliance with federal food, drug, and cosmetic act," form AEC-465. Radioisotopes are classified as new drugs. These two forms AEC-374 and AEC-465, together with the institution's purchase order for a specified number of millicuries of the particular radioisotope are sent back to the supplier designated on the authorization (Form AEC-374) and the project is then ready to start.

This sounds like a formidable amount of preparation for what may turn out to be a relatively small program but actually an effort has been made to reduce it to a minimum compatible with safe and efficient use of the isotopes. Adequate facilities are as necessary for their employment as for any other diagnostic or therapeutic procedure; many others require considerable space and elaborate equipment. Radioactive isotopes are new and dangerous drugs, and a certain degree of control and supervision is necessary until a great deal more information is available.

In summary, the stages of setting up a radioisotope program in any institution are:

1. Establishment of an institution radioisotope committee.

2. If the committee does not include a physicist, and possibly a chemist, experienced in work with radioisotopes, arrangement to have such individuals on a consulting or cooperative basis.

3. Provision and equipment of necessary laboratory space. This includes a minimum of three suitably furnished rooms, two Geiger counters and accessory equipment.

4. Provision of suitable technical help.

5. Assurance that adequate facilities are provided for disposal of radioactive wastes.

6. Obtaining and filing the necessary application blanks, contracts, and purchase orders for the material.

Radiological Research Laboratory
630 West 168th St.
New York 32, N. Y.

Suggested List of Useful Documents Obtainable from the Isotopes Division at Oak Ridge

Catalog and Price List No. 2. (Includes a good deal of information on procurement, costs, etc.)

Isotopes Division Circular D-4. Radioisotopes for Use in Medicine.

Isotopes Division Circular A-3. Techniques in the Handling of Radioactive Isotopes Used in Medical Therapy and the Preparation of Radioactive Colloidal Gold. By C. W. Sheppard and P. F. Hahn. (Includes a good deal of general information on isotope handling.)

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Isotopes Division Circular E-22. List of Consultants on Isotope Techniques. (This list contains very few names of those interested in medical applications of isotopes. If the Commission receives more requests for medical consultants, it will extend this list to take in such individuals.)

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CANCER OF THE LIP*

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A REVIEW of 363 cases of cancer of the lip at the Philadelphia General Hospital was undertaken for the special purpose of evaluating the results of the various technical procedures of irradiation that were employed during the past twenty years. Additional pertinent as well as important factors in the clinical course of the disease were tabulated. These findings closely approximate the results and experiences of other clinics.[1,4,7,9,10,13,14,17]

Cancer of the lip, in reasonably early stages, and in the absence of lymph node metastasis, has been amenable to successful treatment by a manifold variety of technical procedures of irradiation. Even advanced stages of the disease, bulky and infiltrating lesions, without lymph node involvement, may have a good chance of permanent cure by irradiation.

The good results, the marvelous cosmetic effects, the skin and physical tolerance for adequate doses of irradiation in individuals of varying ages, health and strength, and the almost universal knowledge and experience of a rapidly increasing number of well trained radiologists are ample reasons for urging that cancer of the lip be now considered as a radiologic problem.

Individual problems necessitate changes in procedures. Occasionally surgical intervention may be desirable, especially for resistant or recurrent cancers as well as so-called late radiation ulcers.

Surgery for lymph node metastasis must be the first choice of treatment except when the primary lesion is a highly cellular type of growth for which irradiation may be satisfactory.

Of 363 cases in this series, 149, or 42.5 per cent, were failures. But, of these 149 failures, 104 patients were previously treated, or were sufficiently advanced and hopeless on admission to require hospitalization. They were either recurrent or residual cancers, with infection and metastases and generally involved elderly and feeble individuals. Some of these patients received irradiation, but only as a palliative procedure. In the majority of instances, even palliative procedures were discontinued, or not even considered because of progressively failing health and strength.

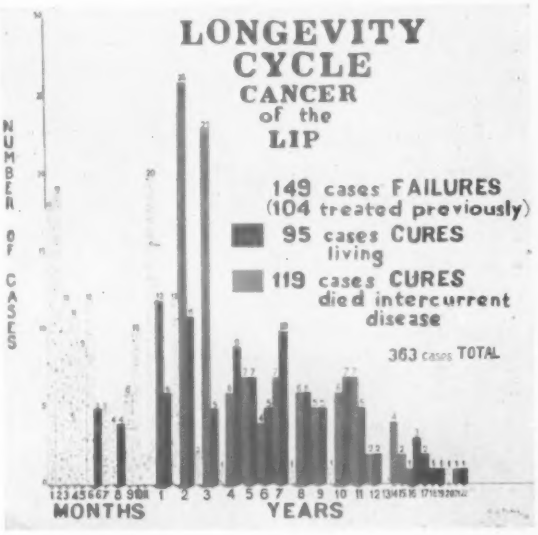

CHART 1. Longevity cycle of cancer of the lip in this series of treated and untreated cases.

Eliminating the group of 104 advanced hopeless cases from the total of 363, the actual number for statistical computation is 259 cases, of which 45, or 17.3 per cent, were failures.

The *curability* rate for cancer of the lip in this series of 259 adequately treated patients was 83 per cent, on the basis of all types of cases, regardless of age, duration and extent of involvement, but in sufficiently good physical condition to tolerate a routine predetermined plan of radiation treatment.

Of 214 clinical cures, 95, or 44 per cent,

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are living six months to twenty-two years; 119, or 56 per cent, were symptom-free six months to twenty-one years but died of intercurrent disease (Chart 1).

The palliative effects of irradiation for the late, advanced cases were not significant for prolonging life except in occasional instances. Since the majority of failures, (104 of a total of 363 cases) had previous treatment or were too advanced for irradiation, the longevity record (Chart 1) is of no value for the failure cases except to show that 38 of these patients lived one year or more; 12 lived two years. A small number of patients had delayed recurrences; of these, 2 lived for 3 years, and 1 patient for each of four, eight, ten, and twenty years respectively.

Lesions involving the buccal commissure and buccal mucosa metastasized frequently and early. The involvement was generally extensive on admission and of a fulminating or rapidly developing type. It was difficult to tabulate these cases because of the frequently inaccurate descriptions of the extent of involvement in the history records, but on the basis of photographs, an estimated failure of at least 90 per cent for this character of involvement seems to be a justified conclusion.

An attempt was made to classify results according to the size of the lesion. This information was generally unreliable. Photographs in many instances were not in accord with the word description of the size. More than one-half of the lesions were in excess of 1.5 cm. in diameter.

The *age incidence* was equally distributed between fifty and eighty years. The incidence under forty years was low, but the possible occurrence of cancer of the lip under thirty years of age is interesting and important.

Syphilis was not considered to be an important etiologic factor. The incidence of a positive Wassermann reaction was only 8 per cent in the cases that had blood studies done. Treatment was not modified in the presence of this complication. There is probably a diminished tolerance to irradiation in the presence of lues. The tissue reactions seemed to be more marked and the healing more delayed. This interpretation may be more apparent than actual but this inference is particularly supported by more striking observations in other irradiated areas, particularly in the intraoral cancers. There was never a problem as to the differential diagnosis. While gumma and cancer of the lip may show a strong resemblance, the microscopic and serologic studies have been conclusive.

Age Incidence in Cancer of the Lip

Years	Number of Cases
23–29	3
30–39	15
40–49	35
50–59	78
60–69	79
70–79	77
80–89	21
90–93	2

Trauma was emphasized by a few patients as a possible causative factor. This statement was always regarded as a factor of aggravation of a pre-existing lesion.

Pipe smoking was a predominant possible etiologic factor in the history of many patients. There is no assurance that the question was always raised. A review of these records by another department of this hospital a few years ago estimated a possible 40 per cent incidence of pipe smokers in these cases of cancer of the lip.

The duration of the disease before adequate treatment undoubtedly influenced the final end results to a considerable degree. This was also a factor of uncertain value. Very often, the statements of individuals were haphazard or indifferent. Advanced hopeless extensive ulcerations were often described as existing one to three months. Small lesions were said to be present as long as several years. There was ample evidence of carelessness in recording data of this character. The tabulated results are therefore of limited value (Chart II).

Approximately 33 per cent of the symptom-free cases presented symptoms longer than a year—largely one to three years before treatment; the "failures," on the

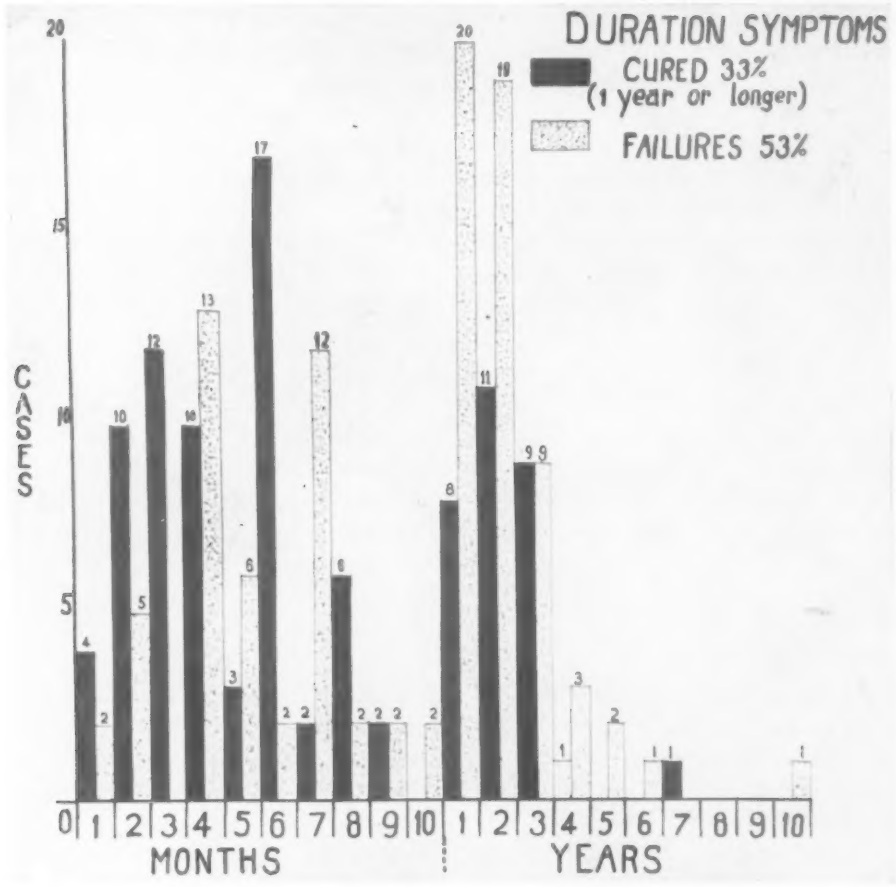

Chart II. Duration of symptoms in the groups of cures and failures.

other hand, showed 53 per cent with symptoms persisting longer than a year. This estimation was based on 100 cases of each "success" and "failure" group where the evidence of onset seemed reliable with respect to fissures, sores, nodules, ulcers, etc. In both groups, there was evidence of some abnormality for longer periods, ranging from three to ten years.

Of the 363 cases, there were 4 females.

The *histopathologic grading* of the tumors in 259 cases was as follows:

Grade 1	119 cases, 46 per cent
Grade 2	51 cases, 20 per cent
Grade 3	25 cases, 10 per cent
Grade 4	3 cases, 1 per cent
Not graded	61 cases, 23 per cent

Results according to the grade of the tumors did not reveal any significant differences except to show evidence of more resistance to irradiation in the highly differentiated lesions and particularly in the ulcerated, nodular, infiltrating, moderately or markedly advanced types of lesions but this was not always the case. It was surprising to find this later type of lesion frequently with a history of a slow development which was a probable factor in the long delay of treatment, usually longer than a year.

Tumor Grades 3 and 4 were usually sensitive to irradiation but resistant characters for these grades were also noted. This experience seems to emphasize the importance of predetermining the plan of treatment according to the experience of the radiologist which will allow the administration of total doses of roentgen rays and radium to the limit of skin tolerance according to the size of the field and the

rate of fractionation of daily intensities of irradiation, rather than any dose calculated according to the specific grade or cellular differentiation of the tumor.

Metastasis rarely occurs in Grade 1 tumors, but is frequent in Grade 4 types. Surgical intervention is strongly recommended for the metastatic lymph nodes secondary to highly differentiated tumors. Conversely, irradiation of enlarged lymph nodes is preferable for highly cellular or anaplastic types of tumors.

Radionecrosis or so-called post-irradiation ulcers occurred in 12 of 259 cases receiving intensive irradiation. Of these 12 patients, 3 received additional treatment because of residual disease which was interpreted to be the result of not including all of the disease in the field of irradiation; 3 patients were treated with interstitial radon in gold "seed' filtration; 4 patients were treated by surface applications of radium and 2 patients were treated by low voltage roentgen rays.

This complication of post-irradiation ulceration, in less than 5 per cent of the treated cases, was not regarded as a serious hazard. Controlled over-treatment is not as dangerous as under-treatment. Diminishing the daily intensity and prolonging the rate of fractionation may have avoided some of the late effects of tissue necrosis. All of these cases were complicated by infection and edema. Sometimes the degree of fibrosis made the interpretation of possible residual carcinoma difficult. Biopsy was usually not satisfactory or conclusive. Attempts to stimulate granulation by repeated scarification resulted in healing of the shallow ulceration in 5 of 12 cases. In 7 patients, a V-shaped surgical excision was done. In no case was residual microscopic evidence of cancer found. In each case, excellent healing and a good cosmetic result were achieved.

Bone necrosis occurred in 23, or 6 per cent, of 363 cases. Of the 259 cases treated at the Philadelphia General Hospital, 9 cases, or 3.5 per cent, developed bone infection. In 7 cases this was the result of extracting teeth six months to two years after completion of successful treatment. In 2 cases the disease had ulcerated to the alveolus. Radiation osteitis may not be amenable to roentgen-ray detection in serial films extending over periods of one to two years or more. This was so in several well controlled cases in this series. Even though the alveolus seems to be effectively protected by meticulous precautions and preparations to obtain distance as well as ample lead protection with thicknesses of 2 to 4 mm. of lead, bone changes occur more often than is realized because they are frequently not of sufficient extent to be amenable to roentgenographic detection. Except for extension of the disease to the bone or possible excessive irradiation or treatment administered too rapidly, this bone complication can be attributed to dental infection or extraction of teeth three or six months or even a year or so longer after clinical healing of the malignant lesion. This occurred in 1 case two years after treatment. Bone infection is precipitated by a failure of the alveolus to close the root canal socket after extractions probably due to fibrosis. The circulatory changes complicating a radiation osteitis are marked and apparently become progressive. Complicating infection usually results in a rapidly developing osteomyelitis. Sometimes the process is slow and may be limited to a shallow superficial bone sequestration. Radical surgical intervention should be delayed unless there is a clinical indication for mandibular resection and disarticulation. The dental problem must be solved before instituting radiation treatment but if apparently healthy teeth should subsequently need radical treatment after a clinical cure by irradiation then the possibility of bone infection may be mitigated by penicillin before and after extraction and the frequent use of saline mouth washes.

TREATMENT

This review shows that roentgen rays and radium have produced equally good results. Interstitial radon—gold filtered

"seeds"—has likewise been effective in 34 cases (Fig. 8). In a few instances platinum needles of 1 to 2 cm. length were employed interstially. The method of interstitial radium has been discarded because surface or so-called contact radium applicators can be made simply and quickly and affords the advantage of fractionation, but also eliminates the risk of damage that may result from the trauma of multiple punctures.

Surgery was never employed except for a few lesions very resistant to irradiation, a few small recurrent cases or in instances of late radionecrosis when possible residual disease was suspected. There are still some clinics which adhere to surgical measures entirely or to selected advanced bulky types of cancers and with excellent results.[6,10]

Fig. 1 and 2. Small lesions suitable for electrodesiccation at time of biopsy, but clinical and cosmetic result more certain and satisfactory by low voltage roentgen rays (100 kv.).

Accurate spacing of the "seeds" or needles interstitially is not a simple procedure. Overlapping of the radiating points may result in necrosis, and wide spacing may result in an unequal distribution of the radiation. Contact application of the radium capsules may be arranged to effect a homogeneous distribution of the beam that may approximate the accuracy of the roentgen rays for the relatively small areas employed for this type of lesion.

Electrodesiccation was satisfactory for small and questionable lesions (Fig. 1 and 2.). It has also been adequate for reasonably large lesion but the cosmetic effect has not equaled the results of irradiation. If the base of the electrodesiccated area of an apparently small lesion at the time of biopsy shows considerable soft bleeding granulation tissue compatible with clinical characters of malignant disease, and if it would appear as though free and wide destruction would be necessary, then radium and preferably low voltage roentgen irradiation is used as described below.

Contact roentgen therapy equipment with voltages of 50 kv. and for distances of 1 to 5 cm. was not available for the treatment of any of these patients. Excellent results have been reported by Chaoul,[3] Pendergrass and Hodes,[13] and Howes and Camiel.[8] This short distance low voltage technique of irradiation is a highly efficient and economical method for delivering large quantities of radiation to small volumes of tissue. The absorption curve closely resembles that of contact radium applications. The rapid fall in depth doses inherent in the method militates against its use in the treatment of lesions more than 1.5 to 2 cm. in thickness.[13] Total fractionated doses have been reported from 3,000 to 6,000 r but increasingly larger doses up to 10,000 r have been necessary for more extensive lesions, and with good results comparable to the results obtained with other qualities of radium and roentgen rays.[3,8,13]

Radium techniques during the past twenty years have varied extensively as to the

daily rate, intensity and total dose. While the procedures in the early days were largely empirical, a systematic control of skin reactions and results finally evolved doses according to the limit of tissue tolerance. Approximating these factors with the subsequent standards of dosage it was gratifying to realize that there was a remarkable similarity in the total doses in relation to the threshold erythema dose (T.E.D.) and the factor of a gamma roentgen. The total doses of radium varied from 6 to 8 T.E.D. according to the size and degree of marginal infiltration. Modifications were made according to the circumstances and individual judgment. The average dose according to the Paterson-Parker charts was found to be 6 T.E.D. (6,000 gamma roentgens) but frequently extended to as much as 8 to 10 T.E.D. and these are the routine predetermined factors that were subsequently followed and rigidly adhered to. It is significant to note that during the days of trial and error successful results were obtained in some cases with total doses of 3 to 4 T.E.D. but these were chiefly small and shallow lesions.

Dental molds to fix the radium tubes were not employed because of difficulties of maintaining good contacts from day to day for protracted treatments. The lesions changed in size and the molds became dry and deformed. Personal early experience demonstrated the hazards of undue exposure to the operator in "setting" the radium tubes into wax molds, and this was especially the case when protracted methods were followed, which also made the procedure very time consuming.

The filtration for radium was a combination of silver and brass—with equivalent metal densities of 0.5 mm. of platinum and in about one-half of the cases 3 mm. of lead and 0.5 mm. of silver, with a metal density equivalent to 2 mm. of platinum were used. The additional filtration did not show any superior results. These filters were used because the radium was available as radon, and delivered to the department in silver tubes, 0.5 mm. wall thickness.

Precautions were taken to displace the soft flexible structure of the lip from the alveolus by gauze packing. This afforded the advantage of support for the radium applicator but also maintained the best protection of distance between the radium applicator and the alveolus. The capsules were spaced 1 cm. apart and fixed between layers of pure vulcanizing rubber. The capsules are 24 mm. in length. A cross-fire method was employed. Special precautions were always taken to arrange the capsules so that the field of irradiation would extend well beyond the visible and palpable extent of the disease—at least 1 to 1.5 cm. A lesion 1.5 cm. in diameter required six capsules to satisfactorily cover the area. The areas of irradiation were noted as external, superior and internal surfaces. In small lesions all three fields were treated at the same sitting. Larger areas, in excess of 2 cm., were treated by alternating one field each day. Excellent fixation of the radium applicator was achieved with adhesive, gauze pads and a firm bandage. Small lesions were frequently treated with the radium capsules fixed by adhesive to a lead strip about 3 mm. in thickness and about 1.5 to 2.5 cm. in width. This applicator was always covered with vulcanizing rubber to eliminate secondary radiations and undue skin reactions.

All radium applications were given in divided doses. A minimum of 6 T.E.D. was always predetermined for shallow lesions, but at least 8 to 10 T.E.D. for large infiltrating ulcerations. If the size of the lesion required 2,000 millicurie-hours to attain a dose of 8 T.E.D. or 8,000 gamma roentgens according to the distance and surface area, the daily treatment would not exceed a dose of more than 200 to 300 mc-hr. There was ample evidence of unduly severe reactions resulting from daily intensities of 400 to 500 mc-hr.

Contact radium applications have the disadvantage of frequent exposure of the operator to the radium. An average of six to eight applications is necessary for each case. Special precautions easily overcome

this disadvantage. The results of contact radium treatment for early and late cancer of the lip equaled the results obtained by any other method of radiation treatment employed by us (Fig. 5, 6, and 7).

Low voltage roentgen radiation has shown uniformly satisfactory results. During the past five years, it has been used routinely for the small shallow lesions, less than 1.5 cm. in diameter (Fig. 1, 2, 3 and 4). The technique has been identical with the routine treatment of cancer of the skin at the Philadelphia General Hospital, as previously described.[16] The results are practically identical for voltages ranging from 80 to 145 kv. and the inherent oil filtration in the average shock-proof tube heads equivalent to 0.5 mm. of aluminum.

Fig. 3 and 4. Ideal types for low voltage roentgen rays or surface applications of radium.

The standard technique involved a dose of 3,000 r (measured in air) for shallow lesions, and 4,500 r for thick and infiltrating lesions—at least 0.5 cm. thick. A lead mask, 0.5 mm. in thickness can be fixed in place with adhesive or with sandbag weights. The lip should be displaced forward by gauze. A lead shield at least 0.5 mm. in thickness wedged into the alveolo-gingival fold affords some protection to the teeth and bone. The aperture in the lead mask should be sufficiently large to include a wide margin of apparently normal tissue—at least 1 to 1.5 cm. according to the size of the lesion. The intensity and rate has been 1,000 r and 1,500 r three times a week for the shallow and thick lesions respectively. The skin and mucous membrane reactions are more severe than usually occurs with the same dose in treating cancer of the skin. This is probably due to the moisture of saliva. If the area of irradiation is larger than 2 cm. in diameter, then the fractionation dose should be reduced to 500 r three times a week and the total dose increased to 3,500 r for shallow and 5,000 r for lesions thicker than 0.5 cm.

High voltage roentgen radiation, 200 kv.,

FIG. 5, 6 and 7. Excellent cosmetic results obtained with contact radium treatments.

and filtrations of 0.25 and 0.5 mm. of copper is preferred for lesions larger than 1.5 cm. in diameter (Fig. 9 and 10). In this series there was photographic evidence of lesions involving a third, one-half or all of the lower lip in more than 40 per cent of the cases. These large lesions required an inclusion of a wider margin of apparently normal tissue than routinely used for the smaller lesions—less than 1.5 cm. in diameter and for which low voltage treatment has been used. Since the treated areas ranged from 2, 3, 4, and 5 cm. in width, and 4 and 7 cm. in length, it was possible to routinely administer the standardized dose of 5,000 r (measured in air) in fractionations of 300 r to portals of 5 by 6 and 6 by 8 cm. and 500 r to portals approximating 4 by 5 cm. Since characteristics of permeation in the skin and subcutaneous structures may exist without clinical manifestations, and since this should be considered as a strong possibility in large bulky infected lesions, of probable long duration because of the marked extent of involvement, the zone of irradiation should extend

especially wide of the apparent extent of involvement. High voltage roentgen rays, 200 kv., are preferred to the lower voltages of 80 to 145 kv. for so-called large lesions because the tissue tolerance has been greater and safer for larger areas. Additional treatment could also be given with more latitude of safety if necessary. The first half of the treatment involved a 4 by 6 or 6 by 6 cm. portal which received 300 r daily or three times a week, according to the convenience of an amublatory patient, little was known about dosage and when treatment procedures were largely empirical, cures were obtained with doses of 3 to 4 T.E.D. according to present day computations. Instances of as much as 10 to 12 T.E.D. were encountered. The particular advantage of using the large area for two-thirds of the treatment is to obtain the undoubted effect of edema and fibrosis which unquestionably mitigates and probably in most instances prevents extension of the disease by permeation or embolism,

Fig. 8. Interstitial radon. Symptom free for twenty-four years.

for a total of 3,000 r (measured in air); treatment was continued after reducing the size of the portal to include tissue about 1 to 1.5 cm. beyond the palpable area of involvement, usually about 4 by 5 cm. for an additional 2,000 r in multiples of 500 r per treatment. Practically all of the lower lip is accordingly treated. The field of irradiation extends to the commissures and to the tip of the chin. The tissue reaction is marked but only for the smaller area. Repair is rapid after about six weeks. The lower alveolus is protected with a lead shield.

Bad teeth, particularly when there is marked pyorrhea, are removed before the institution of irradiation. It may be argued that the dose of 3,000 r extending well beyond the actual area of involvement is not sufficient to sterilize cancer of the lip. This experience has demonstrated that in the early days of radium treatment, when and in many cases undoubtedly sterilizes cancer cells. Since this technique of high voltage roentgen therapy was used in 41 advanced cases, and because the excellent healing and cosmetic effects as well as permanent cures were especially gratifying and dramatic for this character and extent of involvement, it is now used routinely in preference to radium for the more advanced type of case. It is a simple and economical procedure and the plan of fractionation permits relatively large doses to relatively large areas. This treatment is also unusually well tolerated by individuals the majority of whom are beyond middle age, weak and debilitated.

Additional treatment may sometimes be necessary. In several cases in this series the total dose, limited to the smaller areas, was as much as 6,000, 7,000 and 8,000 r (measured in air). These larger doses are necessary in some cases and they are factors

which must be considered as individual problems according to the judgment and experience of the radiologist. The first treatment is important. Residual disease or recurrences are fraught with strong possibility of metastasis. It is usually well to continue treatment beyond the recommended routine of 5,000 r if there is any question or doubt as to possible residual disease. It is better to err on the side of over-treatment than insufficient treatment. Tumor grades should not influence a change in dosage. Different areas of a tumor may show different characters or interpretations of the degree of cellular differentiation. Any particular type of tumor grading may show a radioresistant or radiosensitive response to irradiation. These are clinical manifestations which are very definite and very impressive but unfortunately cannot be clearly tabulated for statistical records.

Enlarged lymph nodes in relation to cancer of the lip must be regarded as an effect of metastasis until proved otherwise. In small and very large bulky lesions, these palpable lymph nodes may be the result of complicating infection. On the chance that actual metastasis may be present, high voltage roentgen therapy, 200 kv. with 0.5 mm. of copper filtration is given. The treatment is localized to the involved area. A small portal, a cone 5 cm. in diameter, is used. This treatment is given concomitantly with the treatment to the lip. Multiples of 500 r daily or every other day are given according to the convenience or facilities of an ambulatory patient. The total dose is 5,000 r and this is sometimes carried to 6,000 and 7,000 r. The skin reaction with desquamation is marked and subsidence occurs in about six to eight weeks. If, at this time, the lymph node enlargement persists, surgical removal is recommended particularly for the Grade 1

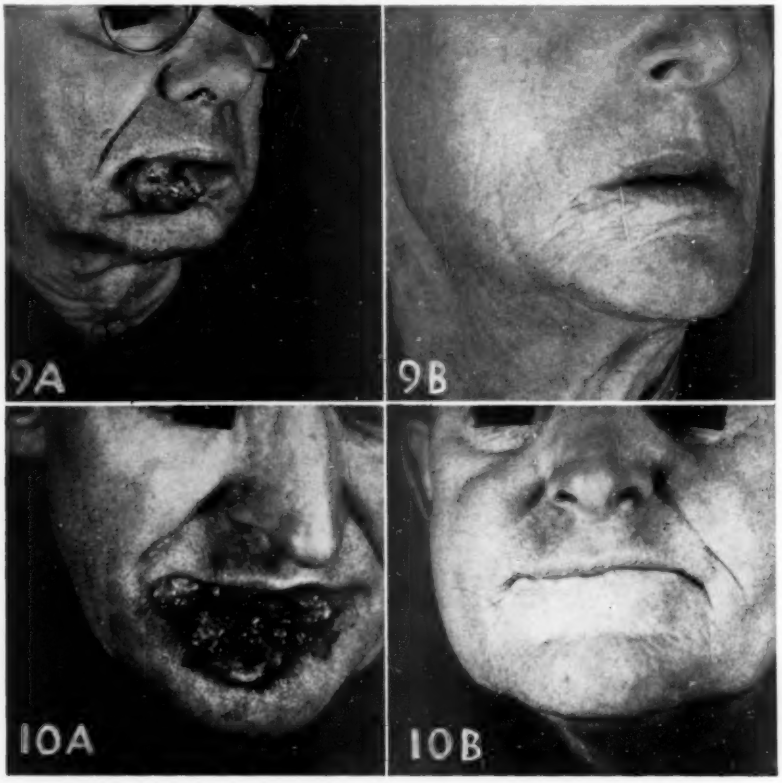

FIG. 9 and 10. Excellent regression of bulky lesions treated by roentgen rays (200 kv.).

and 2 lesions, provided the lesion is intact and movable. In the majority of cases, local removal was not done because the patient or family refused permission but most often the surgical risk was not good. In 17 cases, following roentgen treatment described above, supplementary interstitial radon was given through skin punctures under local anesthesia. Usually five gold "seeds," 1.5 mc., were implanted, 6–8 T.E.D. In 11 cases, there was no clinical evidence of progressive involvement. In practically every case, there was a persistent firmness which was considered to be fibrosis. If scattered or diffusing, matted and fixed characteristics of lymph node involvement exist, then roentgen irradiation to fields large enough to include the affected area is given as a palliative procedure. In only 2 instances was block dissection done. In 1 case, there was no microscopic evidence of clinically suspicious malignant disease and the other case resulted in failure.

Attempts to remove lymph nodes fixed to the mandible resulted in failure on 5 occasions.

There are undoubtedly instances when surgical block dissection should be done, and good results have been reported according to the selection of cases.[11,15] The chance of lymph node metastasis is approximately 10 per cent according to the reported experiences of many large clinics. In this study, there were 94 cases which had palpable lymph nodes on admission but these were largely in the group of 104 cases who were previously treated and were hospitalized because of the advanced stage of the disease. In the group of 259 cases not previously treated, 23, or 9 per cent, had palpable lymph nodes on admission; 13 per cent developed palpable nodes after completion of treatment and apparent clinical cure of the primary lesion.

When the question of surgical intervention arises, the decision should be based upon the indications for neck dissection as outlined by Duffy[5] as follows: healing of the primary lesion; limitation of the lesion to one side of mouth and showing marked histopathologic differentiation; limitation of the enlarged nodes to one group in two contiguous cervical triangles, unilateral and with the capsule intact; metastasis must not be distant and the patient must be in good physical condition.

Prophylactic irradiation to the cervical lymph node region has been done in 46 cases. The total dose averaged 2,000 r (measured in air), but in a few cases, the total dose was 3,000 r. The portals were 10 by 10 cm. and included the submental and submaxillary regions on both sides. In 2 of these cases, uncontrollable metastasis developed. Since this dose is insufficient to sterilize cancer cells in a large percentage of cases, and since the physical strain as a result of the constitutional reaction which accompanied this treatment was sometimes unduly severe, particularly for the aged and already debilitated individuals, the routine of so-called prophylactic neck node irradiation was discontinued. There was no evidence to indicate any benefit.

SUMMARY

1. The technical procedures of irradiation in 259 of 363 cases of cancer of the lip have been discussed and described in detail.

2. The average dose approximates 6 to 8 threshold erythema doses for either radium or roentgen rays of different qualities with equally good results for either one of these agents.

3. High voltage roentgen therapy is recommended for advanced and bulky lesions.

4. Cancer of the lip should now be considered as a radiologic problem.

5. Our experience shows a possible curability of 83 per cent by irradiation procedures for all types of early and advanced cancers of the lip.

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DISCUSSION

DR. EDWARD L. JENKINSON, Chicago, Ill. I think Dr. Widmann has rendered very important service to radiology. He has presented the gospel all over the United States regarding treatment of these superficial malignancies. In fact, he has done much to standardize the method of treatment.

I don't mean to say that he has simplified it to the point where anybody can go ahead and treat these lesions. It is important, of course, that you have some knowledge of the pathology, and the patients should be carefully examined. I think it is important that these patients, when they are treated, be given an adequate dose at the time of the first treatment. Those that recur later on, as you all know, become difficult problems to handle, so if we are going to destroy the lesion and give the patient the best chance of a cure, I think the dosage should be adequate the first time.

I think if we err at all, we err in giving the patient too small a dose. I also think it is important that dental hygiene be taken care of. I don't mean extraction of all the teeth, but I think the mouth should be kept as clean as possible; and I think the lesions respond much better. The quality of the radiation does not seem to be too important in these smaller types of carcinoma. If the lesion is small, and if we can get the needed amount of radiation to the lesion, it does not seem to matter whether we use high or low voltage.

I would like to emphasize, however, four points in this paper. First is the predetermined dosage. I think from Dr. Widmann's experience and experience of others, that these lesions should have at least six to eight and up to ten threshold erythema doses. Second, the results seem to be equally favorable irrespective of the quality of the radiation, providing the lesions, of course, are not too large. If the lesion is bulky, it is probably advisable to use the higher voltage. Third, it seems that fractionation of dosage applies in the treatment of superficial lesion the same as it does in the deep-seated lesion. There may be another advantage also in the fractionated dosage. If 8 to 10 threshold erythema doses are given at one time, it neces-

sitates the patient being quiet for a rather long period of time, and due to movement on the part of the patient, the treatment may extend beyond the point of the lesion. Fourth, it seems from Dr. Widmann's experience and the experience of others that the results are equally good with roentgen rays or radium. That is, they are just as good with roentgen rays as they are with radium. That means, from what he has preached around the country, that a great many institutions who do not have radium but have access to 100 kilovolt roentgen rays can treat most of these lesions if they are familiar with the type of treatment to give.

THE BRONCHOPULMONARY SEGMENTS*

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THE purpose of this paper is to emphasize the importance of the bronchopulmonary divisions of the lung. We set out to clarify the problem in our own institution and soon became aware of the urgent need for a more universal standardization of the classification.

We encountered a surprising lack of reference material in the radiological literature. Segmental anatomy was studied by examination of all bronchograms performed by this department since 1935. The position and configuration of the segments was further studied by reviewing a large number of roentgenograms which demonstrated segmental consolidation or collapse.

The importance of precise identification of bronchopulmonary segments and the need for standardization of nomenclature has recently been emphasized by the development of surgical techniques for pulmonary segmental resection. The bronchopulmonary segment is now considered a surgical unit capable of removal in skilled hands without undue technical difficulties or risks. These techniques are being used with increasing frequency, particularly in the surgical treatment of bronchiectasis where Churchill and Belsey,[11] Blades,[5,6] Overholt and Langer,[22] have demonstrated the surgical importance of the bronchopulmonary units.

In recent years a number of excellent studies have been published (Kramer and Glass,[19] Nelson,[21] Neil, Gilmour and Gwynne,[20] Behr and Huizinga,[4,17,24] Peirce and Stocking,[23] Adams and Davenport,[1] Foster-Carter,[13,14,15] Brock,[8] Jackson and Huber,[18] Foster-Carter and Hoyle[16]) on the anatomy of the bronchi and bronchopulmonary segments.

Despite the considerable variation in the terminology used, there is common recognition of the fact that the lobes are subdivided into secondary units and all writers accept the term bronchopulmonary segments to define these. In 1932 Kramer and Glass[19] defined the bronchopulmonary segment as an area of lung supplied by a relatively constantly placed bronchus whose orifice is situated in a large lobar bronchus and is visible to the bronchoscopist. Adams and Davenport,[1] in 1942, defined these units as subdivisions of the lobe delimited by avascular and diverging planes which may or may not be indicated by complete or partial fissures. The apex of the segment is situated at the hilum and the base comprises an area on the lung surface. Each segment is supplied by integral bronchi and blood vessels which may vary in manner of origin and intercommunication with the hilum but are of relative constancy in their distribution. In 1945 Foster-Carter and Hoyle[16] redefined the bronchopulmonary segment as that portion of lung supplied by a principal branch of a lobar bronchus. This branch is then considered a segmental bronchus. These major or principal branches are relatively constant in all individuals although there may be some variations in their size and shape. We have been conditioned to think of the lungs as being divided into five lobes by the interlobar fissures. However, Nelson,[21] in 1934, suggested that it would be more proper to consider the lungs to be made up of eight lobes instead of five, the lower lobes being made up of two major divisions—the apical portions being designated the superior or dorsal divisions and the inferior parts the basal divisions. The middle lobe on the right, and its anatomical counterpart, the lingula of the left upper lobe, together with the two upper lobes comprise the eight lobes. These are considered by thoracic surgeons to constitute the major surgical divisions of the lungs.

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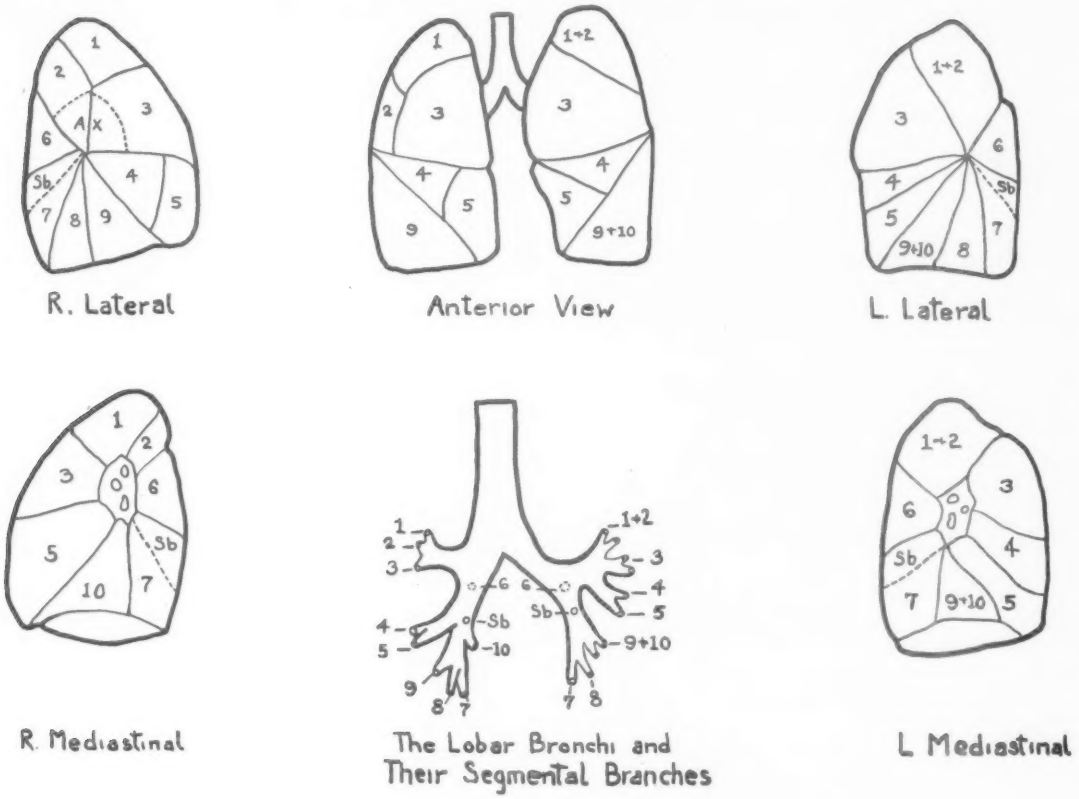

FIG. 1.

Right Lung		*Left Lung*	
Lobes	*Segments*	*Lobes*	*Segments*
Upper	1. Apical 2. Posterior (ax—axillary) 3. Anterior	*Upper*	Upper Division: 1+2. Apical posterior; 3. Anterior Lower (lingular) Division: 4. Superior; 5. Inferior
Middle	4. Lateral 5. Medial		
Lower	6. Superior Sb. Suprabasal 7. Posterior basal 8. Lateral basal 9. Anterior basal 10. Medial basal	*Lower*	6. Superior Sb. Suprabasal 7. Posterior basal 9+10. Anterior-medial basal

The so-called axillary segment of the upper lobe has been included in the diagrammatic representation of the segments because of its roentgenographic entity as explained in the text. It will be noted in the schematic representation of the lobar bronchi and their major segmental branches that each bronchial branch is designated by the name of the subdivision of the lung supplied by it.

Applying the principle of the bronchopulmonary segment, the next logical step is to divide further the eight lobes into their corresponding bronchopulmonary units. This has been done by various contributors mentioned in the preceding references and a fairly uniformly characteristic pattern based on the segmental bronchi has been evolved. Therefore, while the largest segments into which each lobe is divided by segmental bronchial distribution are of considerable clinical importance, it must

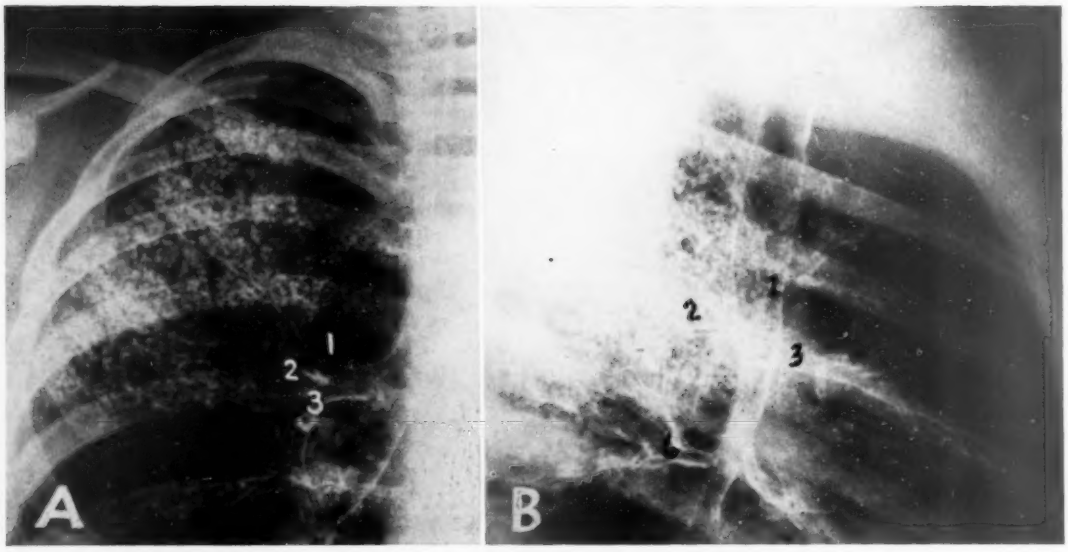

FIG. 2. (*A*) Bronchogram in posteroanterior projection showing the usual trifurcation of the right upper lobe bronchus into (*1*) apical, (*2*) posterior and (*3*) anterior segmental bronchi. The posterior bronchopulmonary segment is outlined by the iodized oil. (*B*) Lateral projection showing the trifurcation of the right upper lobe bronchus and the posterior bronchopulmonary segment outlined by the iodized oil. (*6*) represents superior segmental bronchus right lower lobe.

nevertheless be realized that these do not constitute the smallest units, for each principal segmental bronchus divides into smaller branch bronchi which in turn supply a pulmonary segment. However, the smaller units, at present, have an extremely limited clinical application and for all practical purposes are only of academic interest.

NOMENCLATURE

The need for a standardized nomenclature acceptable to roentgenologist, thoracic surgeon, internist, bronchoscopist, and anatomist is recognized by all. The lack of uniformity ever since the early anatomical studies of Aeby[2] and Ewart[12] has resulted in considerable confusion.

Having reviewed the variously presented terminologies, it is our opinion that the nomenclature suggested by Jackson and Huber[18] is best suited to meet the practical needs of all medical specialties for two principal reasons: First, because their classification has been predicated on the fact that the largest segments into which each lobe is divided is of the greatest clinical importance. Second, their nomenclature is the simplest and most consistent of any suggested. They have adopted as a common basis for the choice of all names the position of the segment in the lobe, and the corresponding segmental bronchi are designated by the names of the segments they supply. This classification, it will be noted, divides the lung into ten major segments on the right and eight on the left. Figure 1 illustrates the bronchopulmonary segments and the major segmentation of the bronchial tree. Incidentally, we have observed (as had Brock[8]) that the usual upper limit of the oblique fissure is located on a plane with the fifth rib or interspace posteriorly. This is significantly lower than the position given in most anatomical texts.

ROENTGENOLOGICAL FEATURES OF SEGMENTAL ANATOMY AND PATHOLOGY

Disease processes of many kinds such as neoplasm, pneumonia, abscess, infarct, bronchiectasis and tuberculosis, may and frequently do confine themselves to one or several lung segments and it is the roentgenologist's responsibility to interpret

within practical anatomical exactness not only in which lobes morbid changes exist but also in which segments the pathological condition is located. Churchill and Belsey,[11] in their paper on "Segmental Pneumonectomy" in 1939, referring to the surgical treatment of bronchiectasis, stressed the importance of preoperatively delineating the complete pattern of the disease for, as they stated, failure to do so is the first step toward unsatisfactory operative results.

To the classical studies of Ewart[12] we are indebted for the first detailed description of bronchopulmonary anatomy. In addition to the studies on bronchopulmonary anatomy already referred to, those of Appleton,[3] Brock,[9,10] and Boyden[7] are of added interest.

Diseased segments are generally recognized roentgenographically by their shape, density and the position they occupy in relation to the lobe and to the neighboring fissures. A knowledge, therefore, of the basic pattern of the bronchi and major pulmonary segments and their roentgenologic features in consolidation and collapse will greatly facilitate the recognition of the majority of segmental lesions.

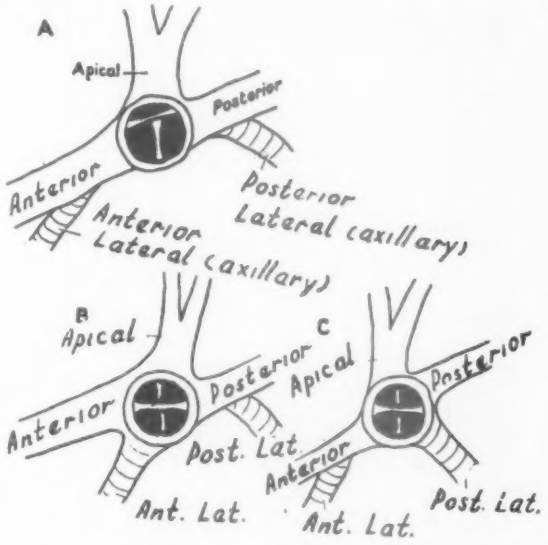

Fig. 3. Variations in branching of right upper lobe bronchus and the lateral branches of anterior and posterior segmental bronchi (adapted from Appleton). *A* represents the usual pattern of the right upper lobe bronchus dividing into the three segmental bronchi; *B* illustrates one variation showing the lateral branch of the anterior segmental bronchus arising as a separate stem from the upper lobe bronchus; *C* illustrates the lateral branch of the posterior segmental bronchus as a separate stem from the upper lobe bronchus. Variation not shown is where two of the three segmental bronchi have a common orifice with the upper lobe bronchus. These variations account for the not infrequent roentgenographic appearance of a so-called axillary segment.

RIGHT BRONCHIAL TREE AND LUNG SEGMENTS

Right Upper Lobe Bronchus. The upper lobe bronchus on the right has been found to divide commonly into three segments—apical, posterior and anterior (Fig. 2*A* and *B*). Each of these segmental bronchi divides into two major rami. The apical has an apical and posterior branch; the posterior has a lateral and posterior branch; the anterior has an anterior and lateral branch. Variations in arrangements of the three major bronchi are by no means uncommon and have been described by Kramer and Glass,[19] Neil, Gilmour and Gwynne,[20] Appleton,[3] Boyden,[7] and Foster-Carter.[13,14,15] It has been demonstrated that variations arise primarily in two ways: The lateral (axillary) branch of either the anterior or the posterior segmental bronchi may open directly into the upper lobe bronchus, or two of the three segmental bronchi (apical, posterior, anterior) may share a common opening into the upper lobe bronchus.

Appleton,[3] in a dissection of one hundred lungs, fifty of each side, found frequent variations in the segmentation of the right upper lobe bronchus. Some of these variations taken from Appleton are illustrated in Figure 3. Therefore, since the lateral (axillary) branches of the anterior or the posterior segmental bronchus may arise as separate stems from the upper lobe bronchus, the segments of lung supplied by them will necessarily have a status independent of the three main segments. Roentgenologists are familiar with the roentgenographic appearance resulting from this variation (Fig. 4*A* and *B*). Some writ-

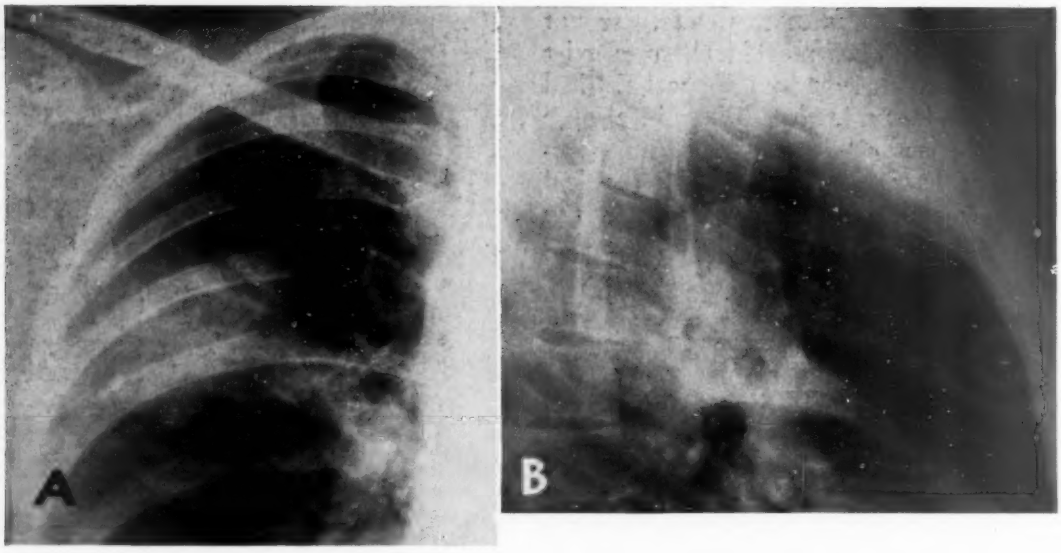

FIG. 4. (*A*) Pneumonic consolidation of lateral branch of right posterior segmental bronchus. (*B*) Lateral projection of (*A*) showing the area of consolidation limited to the axillary area—so-called axillary segment.

ers (Kramer and Glass,[19] Neil, Gilmour and Gwynne,[20] Adams and Davenport[1]) have felt that this variation is sufficiently important to be worthy of representation as a separate segment (see Fig. 1). However, the lateral branches of the anterior and posterior segmental bronchi have never been found to share a common opening and the existence of an axillary segment as an anatomical entity has never been demonstrated. Its existence as a roentgenological entity as illustrated in Figure 4*B* is explained by the variations in segmentation described.

RIGHT UPPER LOBE SEGMENTS

1. *Apical Segment.* Consolidation of this segment, as seen on the posteroanterior projection, reveals a dense opacity occupying the apex of the lung. The upper border is bounded by the dome of the pleura. The medial border lies in apposition to the mediastinum and extends downward to the superior margin of the hilum. The lateral border extends in a slight concavity upward and outward from the hilum to the lateral chest wall at the level of the first rib. In the lateral view the shadow extends from the apex to the region of the hilum in the shape of a V, but may be difficult to clearly distinguish because of the superimposition of the shoulder girdle (Fig. 5*A* and *B*).

Collapse of this segment is usually visualized with considerable difficulty due to the fact that the segment shrinks inward toward the mediastinum. The only roentgenographic indication of collapse may be a very slight widening of the superior mediastinum in the posteroanterior projection.

2. *Posterior Segment.* Consolidation of this segment, as seen on the posteroanterior view, simulates to some extent that of the anterior segment. The shadow, however, is usually smaller and its greatest density is peripheral. The medial border is indistinct and a clear area is usually seen between it and the mediastinum. The lower border extends horizontally from the hilar region to the lateral chest wall, at about the level of the third anterior interspace. The upper border runs obliquely upward and outward from about the level of the second costal cartilage to the level of the first rib at the lateral chest wall and above this border is seen the radiolucent apical segment. On the lateral view there is a well defined posterior shadow distinctly quadrilateral in outline.

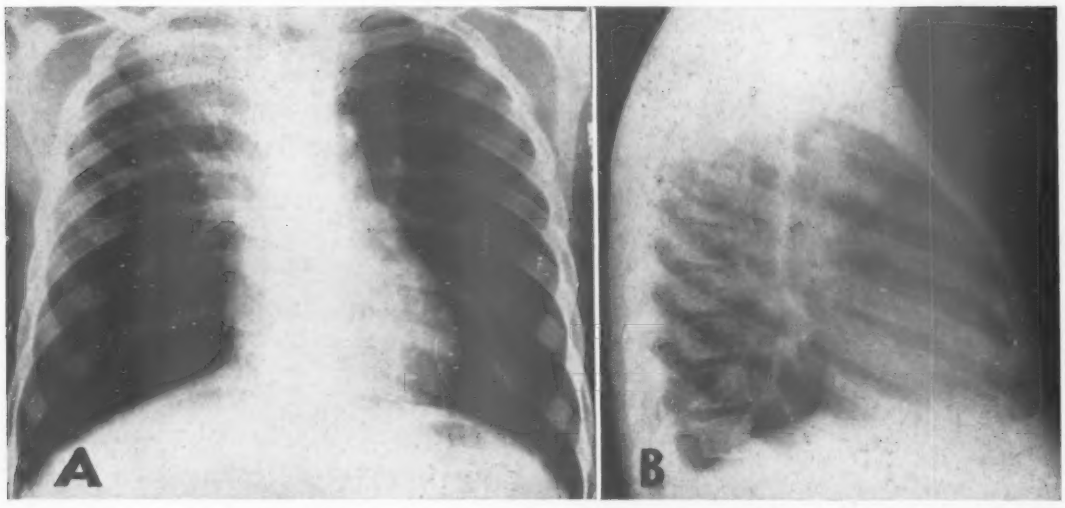

Fig. 5. (*A*) Pneumonic consolidation apical segment—right upper lobe in nine year old boy. Right transverse fissure in normal position. Complete resolution seven days. (*B*) Lateral view of (*A*). The V-shaped consolidation is partially obscured by the imposition of shadow of shoulder girdle.

The lower border is well delimited by the oblique fissure and extends upward and backward from the hilum to the level of the upper border of the fifth thoracic vertebra. The anterior border at the mid-axillary line extends upward to merge with the upper border which in turn extends sharply upward and backward to the level of the second or third thoracic vertebra (Fig. 6*A* and *B*).

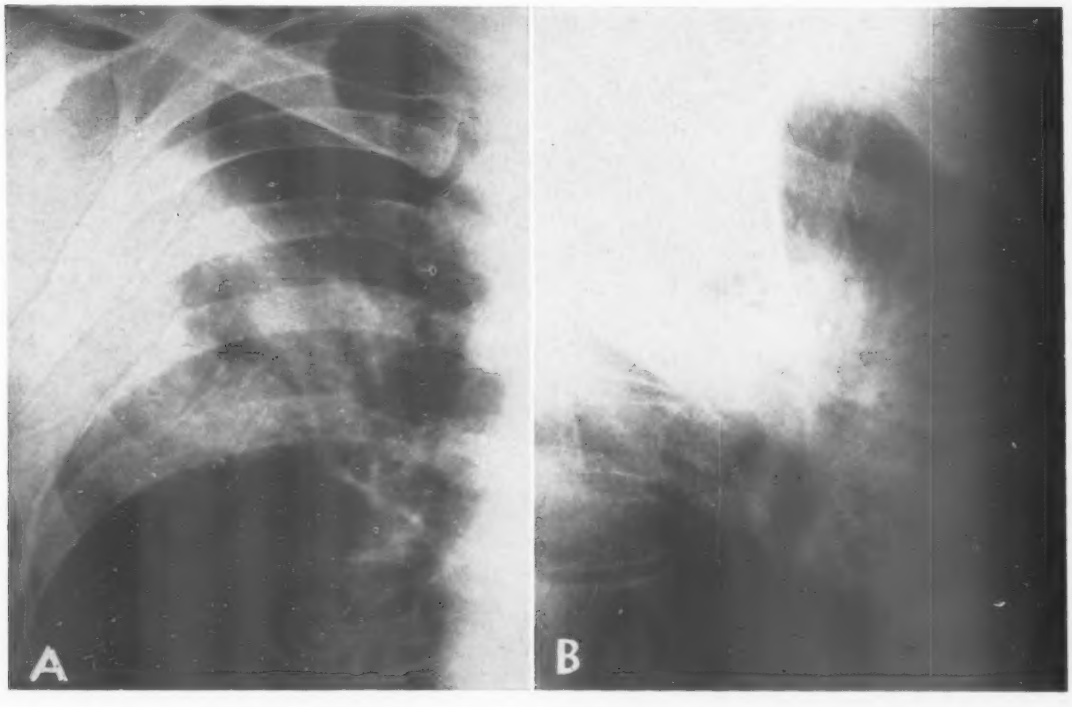

Fig. 6. (*A*) Consolidation of posterior segment of right upper lobe by lung abscess. (*B*) Lateral view of (*A*) showing consolidation of posterior segment and lung abscess.

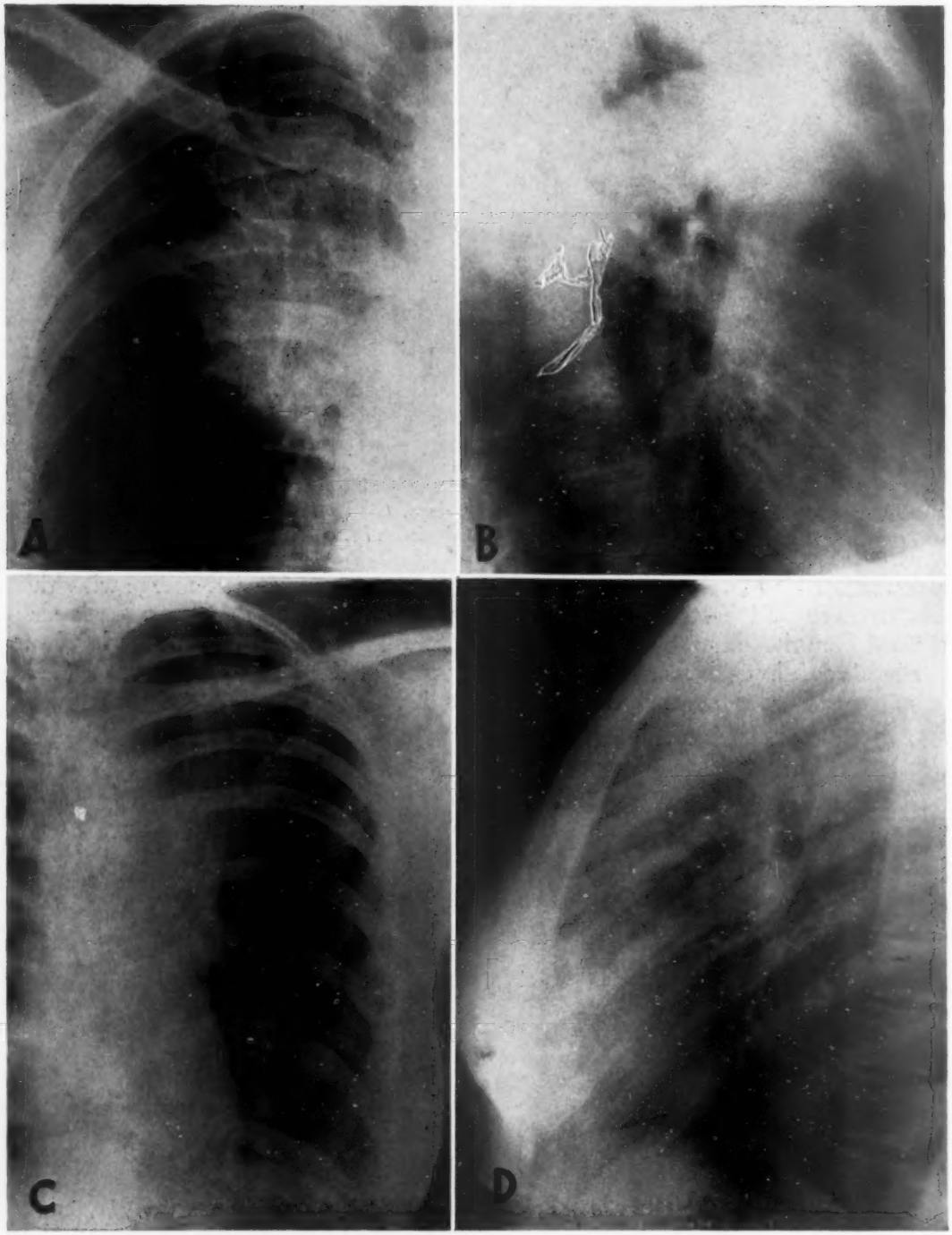

FIG. 7. (*A*) Consolidation with some associated collapse of right anterior segment. Proved bronchogenic carcinoma involving anterior segmental bronchus. (*B*) Lateral view of (*A*). The anterior segment is clearly defined. The partial reduction in volume indicates some degree of associated collapse. (*C*) Collapsed anterior segment left upper lobe in a patient with pulmonary tuberculosis and endobronchial disease. (*D*) Lateral roentgenogram of (*C*) showing narrow band of density anteriorly occupying retrosternal clear space representing collapsed anterior segment.

Partial collapse of this segment casts an indefinite peripheral shadow in the posteroanterior view but in the lateral view it is well defined. In complete collapse nothing more than a very narrow linear shadow is seen and might be mistaken for thickening of the interlobar fissure.

It is generally recognized that the posterior bronchopulmonary segment is clinically the most important segment in the right upper lobe (Brock, Hodgkiss and Jones[10]). This because the posteriorly placed orifice of this segmental bronchus is the first to become infected by inhalation or aspiration of infected material from the upper respiratory tract as is seen so frequently in the minimal stage of the reinfection phase of tuberculosis.

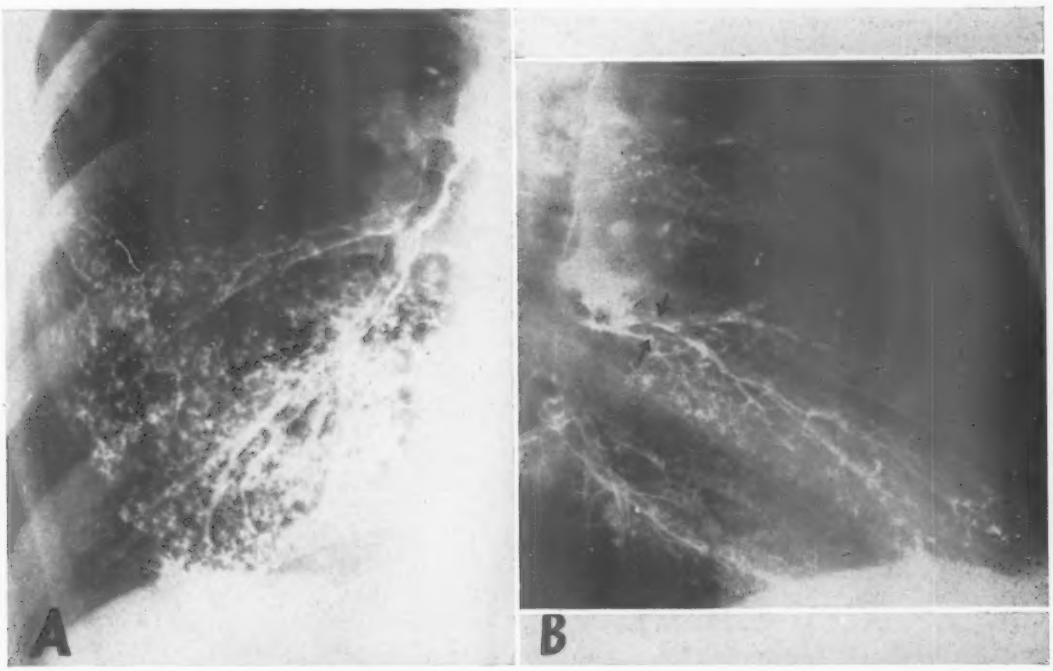

Fig. 8. (*A*) Bronchogram in posteroanterior projection visualizing right middle lobe bronchus and its lateral and medial segmental branches. (*B*) Lateral roentgenogram of (*A*). Upper arrow, lateral segmental bronchus; lower arrow, medial segmental bronchus right middle lobe.

3. *Anterior Segment.* Consolidation of this segment, as seen in the posteroanterior view, appears as a homogeneous density, roughly quadrilateral in shape, extending from the hilum to the anterior axillary line. The lower border is usually on a level with the fourth costal cartilage and is sharply delimited by the transverse fissure. The upper border is at the level of the first costochondral junction. In the lateral projection consolidation of this segment is seen as an anterior wedge-shaped density with the apex pointing to the hilum. The lower border is formed by the transverse fissure and is clearly defined. The density extends backward to about the mid-axillary line where it joins a short vertical posterior margin which in turn merges with the upper border. The upper border extends in a line upward and forward from the hilum to the anterior chest wall at about the level of the first costal cartilage (Fig. 7*A* and *B*).

Collapse of the segment reduces the size and extent of the shadow in direct proportion to the degree of collapse (Fig. 7*C* and *D*). Complete collapse simulates very closely an interlobar effusion from which it must be differentiated. In the posteroanterior view complete collapse of this segment produces a small parahilar density at

the medial end of the transverse fissure, while in the lateral projection a narrow band of density is seen just above the transverse fissure.

RIGHT MIDDLE LOBE

The right middle lobe bronchus divides into medial and lateral segmental bronchi which supply the two major segments of this lobe (Fig. 8*A* and *B*). Foster-Carter and Hoyle[16] (1945) state that segmental mid-lung field. Its upper border lies on the transverse fissure and the medial border is indistinct. In the lateral view the shadow is also roughly triangular in shape, extending forward and downward from the hilum with a rather sharply delimited anterior margin marking the division between the two segments of the lobe (Fig. 9*A* and *B*). Collapse of this segment in the posteroanterior projection is seen as an ill defined density just below the lateral half of the de-

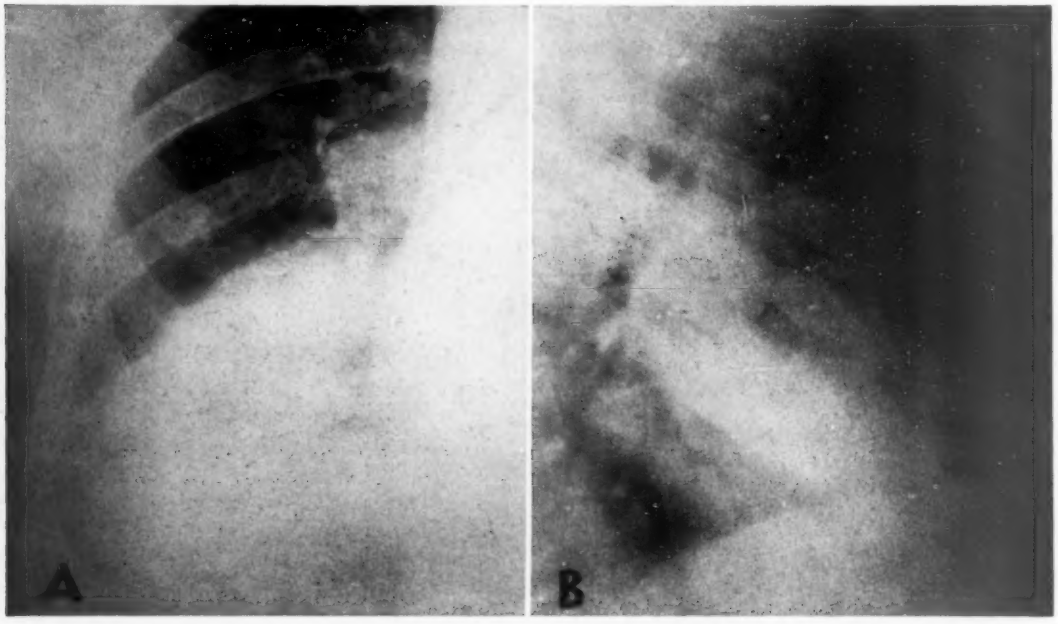

FIG. 9. (*A*) Consolidation of lateral segment right middle lobe in a patient with pneumonia. Note clear zone between medial border of consolidation and right heart border which is sharp and clearly defined. Compare with Figure 11*A* where the medial segment is involved and there is complete obscuration of right heart border. (*B*) Lateral roentgenogram of (*A*). The sharply delimited anterior border of the consolidation is well demonstrated and marks the division between the two segments of this lobe.

collapse in the right middle lobe is uncommon. Robbins and Hale,[25] however, have found in their experience segmental collapse to be more common than collapse of the entire lobe. We, also, have found segmental collapse of this lobe to be a common occurrence with the medial segment being most frequently involved.

4. *Lateral Segment.* Consolidation of this segment, as seen in the posteroanterior view, appears usually as a roughly triangular density in the lateral half of the right pressed transverse fissure. In the lateral projection it appears as a narrow band of increased density superimposed on the heart shadow just above and anterior to the lower half of the oblique fissure.

5. *Medial Segment.* Consolidation of this segment in the posteroanterior projection is viewed as a roughly quadrangular density in apposition with the right heart border and extending about half way across the lung field (Fig. 10*A*). The lateral view shows the density to be triangular in shape

with its base against the anterior chest wall and its apex pointing to the hilum. The anterior part of the shadow is quite dense but the density decreases towards the hilum (Fig. 10*B*).

Difficulty may arise in differentiating collapse of the middle segment from that of the entire lobe, since in both instances obscuration of the right border of the heart occurs. Careful attention to the location and shape of the density and demonstration of the transverse fissure in its normal position will aid in the differentiation.

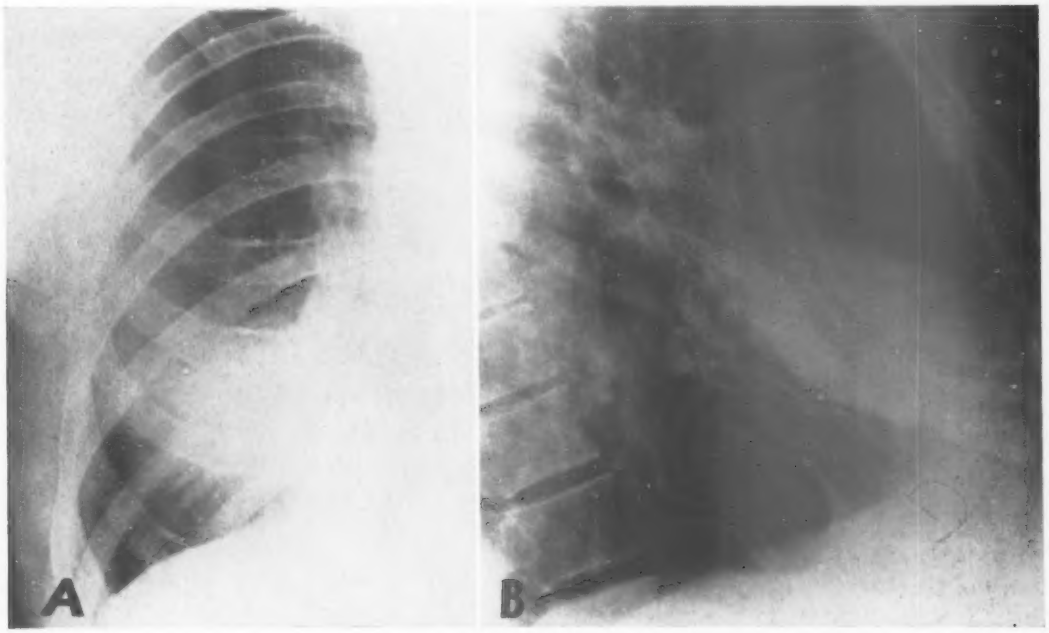

Fig. 10. (*A*) Posteroanterior roentgenogram of consolidation of medial segment right middle lobe by a bronchogenic carcinoma. Pneumonectomy was done and the medial segmental bronchus was found to be occluded. Note the quadrangular outline of the consolidated segment; also how it obscures the right heart border and extends midway across the lung field. Note also the clearly defined transverse fissure in normal position. (*B*) Lateral projection of (*A*). The density is somewhat triangular in outline with the base against the anterior chest wall and apex toward the hilum. The greatest density is at the base. Note normal radiolucent lung between the apex of the density and the hilum, representing uninvolved lateral segment.

Appleton[3] has described an interesting and clinically important variation in the middle lobe. He found, in addition to the vertical fissure which is occasionally present and separates the lobe into lateral and medial segments, a horizontal cleft dividing the medial segment into an upper and lower part. This cleft, when present, might be mistaken for the true transverse fissure if this latter were absent. He further calls attention to the consequence of such an arrangement, namely, that the upper lobe would appear to receive a bronchus from the middle lobe bronchus and, second, the thoracic surgeon, unaware of the anomalous nature of the fissure, might mistake it for the true horizontal fissure and, in attempting a separation with a view toward performing a lobectomy, would find the separation obstructed by a branch of the middle lobe bronchus far in front of the hilum.

RIGHT LOWER LOBE

6. *Superior Segment.* The superior segment is located in the apical and dorsal portions of the lower lobe. Other terms that have been applied to this segment are: dorsal (Nelson, and Adams and Davenport), apical (Kramer and Glass, and Neil, and others), posterior-horizontal (Ewart),

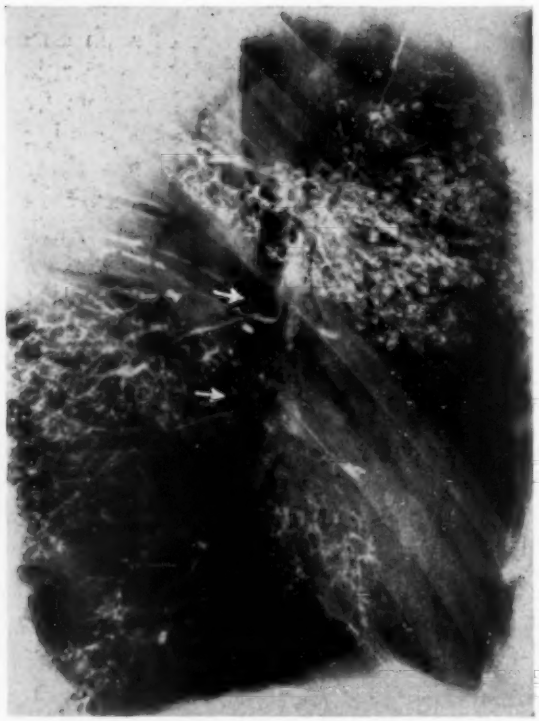

FIG. 11. Lateral bronchogram showing right superior segmental bronchus (upper white arrow). The superior bronchopulmonic segment is partially outlined by iodized oil. Incidentally, the anterior bronchopulmonary segment of the right upper lobe is clearly outlined by lipiodol as is the lateral branch of the posterior segmental bronchus. The lower white arrow points to the suprabasal segmental bronchus.

first dorsal (Aeby). It is supplied by a large dorsally placed segmental bronchus which arises from the main stem bronchus opposite the bronchus for the middle lobe (Fig. 11). This segment, as Nelson[21] and others have demonstrated, occasionally is separated by a well defined fissure and is considered by thoracic surgeons as a lobar entity distinct from the other basal segments.

Segmental involvement of the superior segment occurs quite commonly. Basal tuberculosis is frequently confined to this bronchopulmonary unit. Consolidation of this segment in the posteroanterior view appears as a large, roughly semicircular shadow lying in apposition to the heart border, extending across the mid-lung field. The upper border is convex and extends to about the level of the sixth or seventh rib posteriorly. The lower border is horizontal or slightly concave and usually extends down to about the level of the ninth rib posteriorly. In the lateral view the density has a characteristic triangular outline with its base on the posterior chest wall and apex at the mid-axillary line. The upper

FIG. 12. Lateral bronchogram illustrating suprabasal bronchi (lower white arrow). Their origin from the main stem bronchus between the orifices for superior segmental bronchus and posterior basal segmental bronchi is clearly shown. The upper white arrow points to superior segmental bronchus.

margin is sharply defined by the upper half of the oblique fissure while the lower margin slopes downward and backward from the mid-axillary line to about the level of the tenth thoracic vertebra (Fig. 14*A* and *B*).

Collapse of this segment on the posteroanterior view is seen as a rather small irregularly outlined parahilar density. In the lateral view it casts a narrow wedge-like opacity and the interlobar fissure is usually

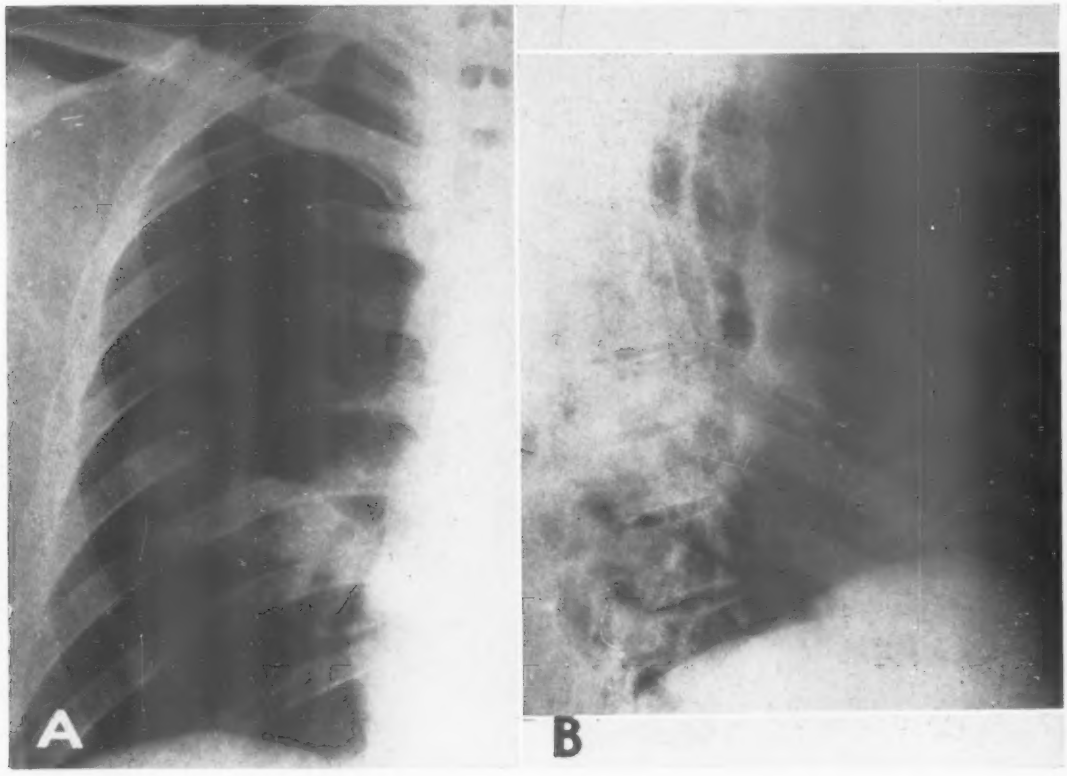

Fig. 13. (*A*) Posteroanterior roentgenogram showing consolidation of suprabasal segment in a patient with pneumonia. (*B*) Lateral roentgenogram of (*A*). Small triangular density located posteriorly with base on posterior chest wall overlying the bodies of the ninth and tenth dorsal vertebrae. This subsegment is situated just inferior to the superior segment and superior to the posterior basal segment.

depressed to a more horizontal position (Fig. 14*C* and *D*).

Smaller bronchi not infrequently arise from the dorsal aspect of the main stem bronchus between the bronchus of the superior segment and those of the posterior basal segment (Fig. 12). Neil, Gilmour and Gwynne[20] described and emphasized the importance of these and called them subapical bronchi. They had previously been recognized by Ewart.[12] Jackson and Huber[18] suggested these be called suprabasal bronchi, and the subsegment which they supply is therefore referred to by the same name. Neil *et al.*[20] found that these bronchi varied in number from one to three on the right while on the left there is usually only one. In our studies of the roentgen anatomy of the lung we were impressed with the importance of this segment. Disease processes confined to this subdivision were encountered with sufficient frequency to warrant special mention (Fig. 13*A*, *B*).

7. *Posterior Basal Segment.* The bronchus supplying this segment represents the terminal part of the main stem bronchus and gives off a number of small dorsal and lateral branches. Segmental involvement is frequently seen. Consolidation, in the posteroanterior view, appears as a dense shadow obliterating the cardiophrenic angle (Fig. 15*A*). On the left the density is seen through the heart shadow. In the lateral view the consolidated segment is seen as a well defined triangular opacity with its apex at the hilum and the base in the posterior costophrenic sulcus (Fig. 15*B*).

Collapse of the segment reduces the size of the shadow in the posteroanterior view and in the lateral view the triangularity of outline is lost, being replaced by a long narrow band.

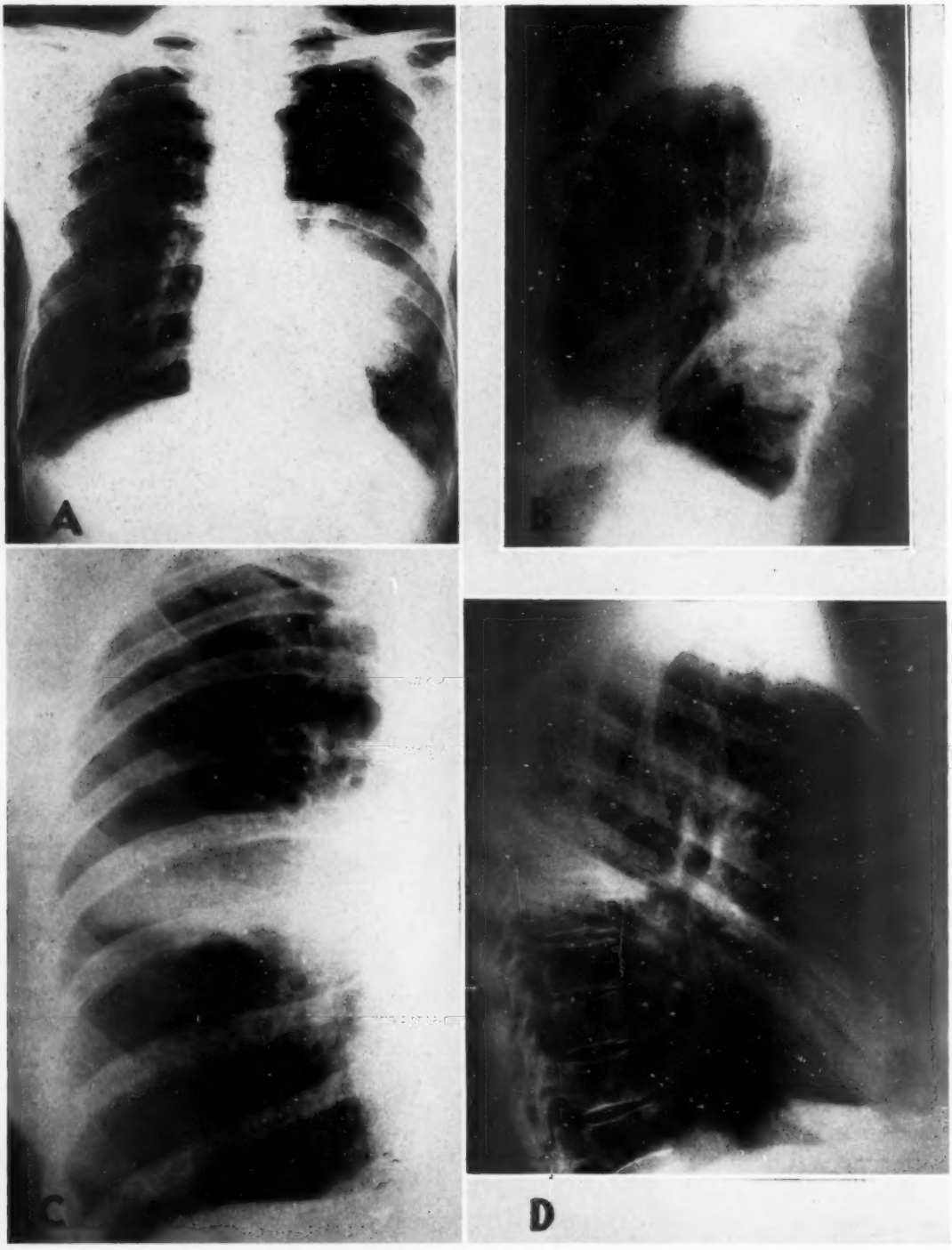

FIG. 14. (*A*) Posteroanterior roentgenogram illustrating consolidation of the left superior segment caused by a bronchogenic carcinoma involving the superior segmental bronchus. Note the semicircular outline of the consolidation with convexity of the upper border and lower border at the level of the tenth rib posteriorly. (*B*) Lateral view of (*A*) demonstrating very clearly the characteristic triangular outline with the base on posterior chest wall and the apex at the mid-axillary line. The upper border is sharply delimited by the oblique fissure. The lower border extends downward and backward from the mid-axillary line to the level of the tenth thoracic vertebra. (*C*) Posteroanterior roentgenogram illustrating partial collapse of right superior basal segment in a patient with pneumonia. (*D*) Lateral roentgenogram of (*C*) demonstrating narrow wedge-like density posteriorly just below oblique fissure. The upper border is formed by the posterior portion of the oblique fissure. The apex extends to mid-axillary line and the base is resting on the posterior chest wall.

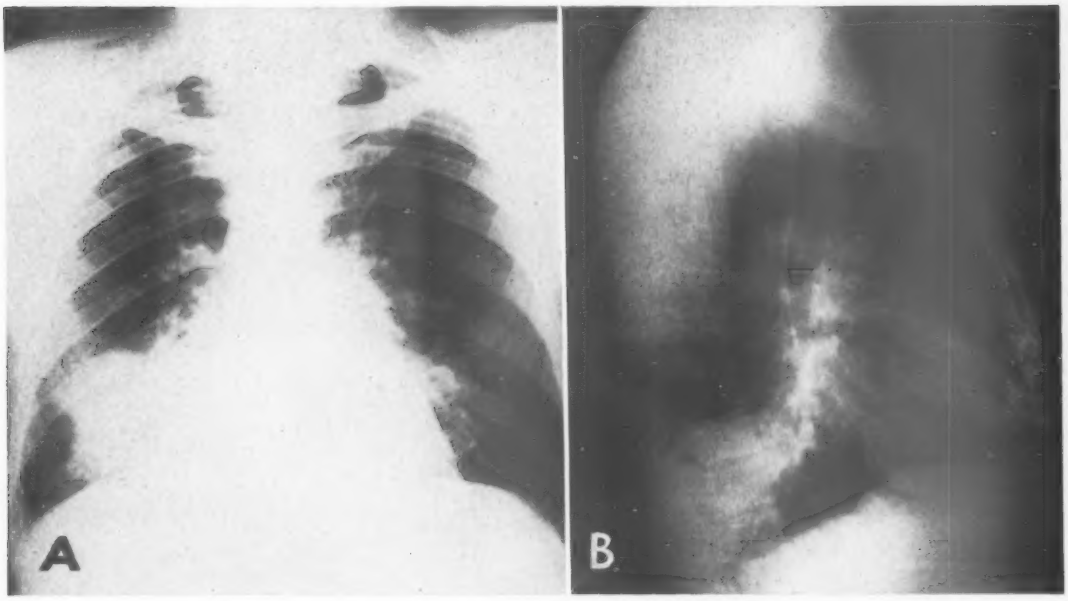

Fig. 15. (*A*) Consolidation of right posterior basal segment by proved bronchogenic carcinoma. (*B*) Lateral roentgenogram of (*A*); note the triangularity of density with apex at hilum and base in posterior costophrenic sulcus.

8. *Lateral Basal Segment.* The segmental bronchus supplying this segment represents the second ventral branch of the main stem to the lower lobe and its course is downward and lateral. Consolidation or collapse of this segment occupies, on the posteroanterior view, the same location as that of the anterior basal segment except that it is usually smaller and confined more to the region of the costophrenic angle (Fig. 16*A*). On the lateral view the appearance is also similar to that of the anterior basal segment, but the shadow is situated more posteriorly and the anterior and posterior margins are not usually as sharply defined. This segment may lie almost directly lateral to the posterior basal segment and, when this occurs, it cannot be distinguished from posterior basal consolidation on the lateral view alone (Fig. 16*B*).

9. *Anterior Basal Segment.* This segment supplied by the bronchus of the same name represents the first ventral branch of the main stem and is directed downward, forward and laterally. Consolidation of this segment in the posteroanterior view appears as a cuneiform opacity with the base resting on the lateral half of the diaphragm partially obscuring the costophrenic sulcus. The apex of the shadow is at the hilum. The upper border extends from the hilum in a slight concavity downward and laterally to the chest wall at about the level of the fourth rib in the axillary line. The lower border reaches downward and outward from the hilum to about the mid-portion of the diaphragm. The cardiophrenic angle is clear (Fig. 17*A*). In the lateral view a characteristic wide band-like density is seen extending from the hilum to the anterior portion of the diaphragm. The anterior border is sharply defined by the lower half of the oblique fissure. The posterior margin is also well delimited and is nearly parallel to the anterior border converging slightly at the hilum (Fig. 17*B*). Consolidation of the anterior basal segment must be differentiated from interlobar effusion. The latter presents a more uniformly dense shadow and on the lateral view is definitely fusiform in shape.

Collapse of this segment in the posteroanterior view causes a poorly defined patchy density in the region of the lateral

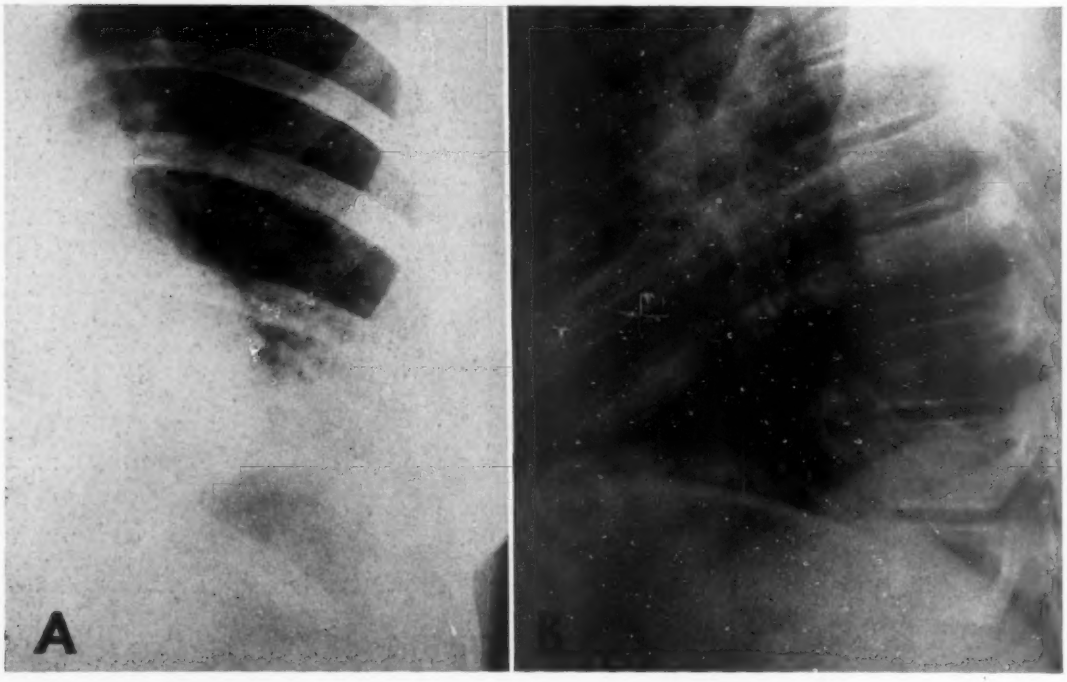

FIG. 16. (*A*) Posteroanterior roentgenogram showing pneumonic infiltration of left lateral basal segment; note patchy infiltration lateral portion of left base in region of costophrenic angle. (*B*) Lateral view of (*A*). Note the linear infiltration extending from hilum downward and posteriorly. In this instance the lateral segmental bronchus lies lateral to the posterior basal segmental bronchus; the infiltration on the lateral projection would appear to be in the posterior basal segment. However, the posteroanterior view clearly shows its lateral location.

portion of the basal lung field above the costophrenic angle. In the lateral view a narrow band-like density along the interlobar fissure may be mistaken for thickening of this fissure (Fig. 17*C* and *D*).

10. *Medial Basal Segment.* This segment commonly has an independent status and is supplied by the medial segmental bronchus which is a major branch of the main stem bronchus to the right lower lobe. It has its origin slightly above and medial to the anterior basal segmental bronchus. Occasionally, this segment is separated by a well defined fissure. Consolidation is seen as a density with the base on the diaphragm and apex at the hilum, situated in the cardiophrenic angle with its medial border partially obscured by the right heart border (Fig. 18*A*). In the lateral exposure it appears as a small triangular density with the base resting on the mid-portion of the diaphragm and the apex pointing upward toward the hilum (Fig. 18*B*).

Collapse of this segment is usually hidden by the heart shadow on the posteroanterior view but on the lateral film is seen as a narrow band running vertically downward from the hilum to about the mid-portion of the diaphragm.

LEFT BRONCHIAL TREE AND LUNG SEGMENTS

Left Upper Lobe Bronchus. This lobe of the left lung is the counterpart of the combined upper and middle lobes of the right lung. The left upper lobe bronchus divides soon after leaving the left main bronchus into ascending and descending trunks designated by Adams and Davenport[1] as upper and lower divisions. The upper division is the equivalent of the right upper lobe bronchus whereas the lower division, supplying the lingula, is the equivalent of the right middle lobe bronchus. The upper

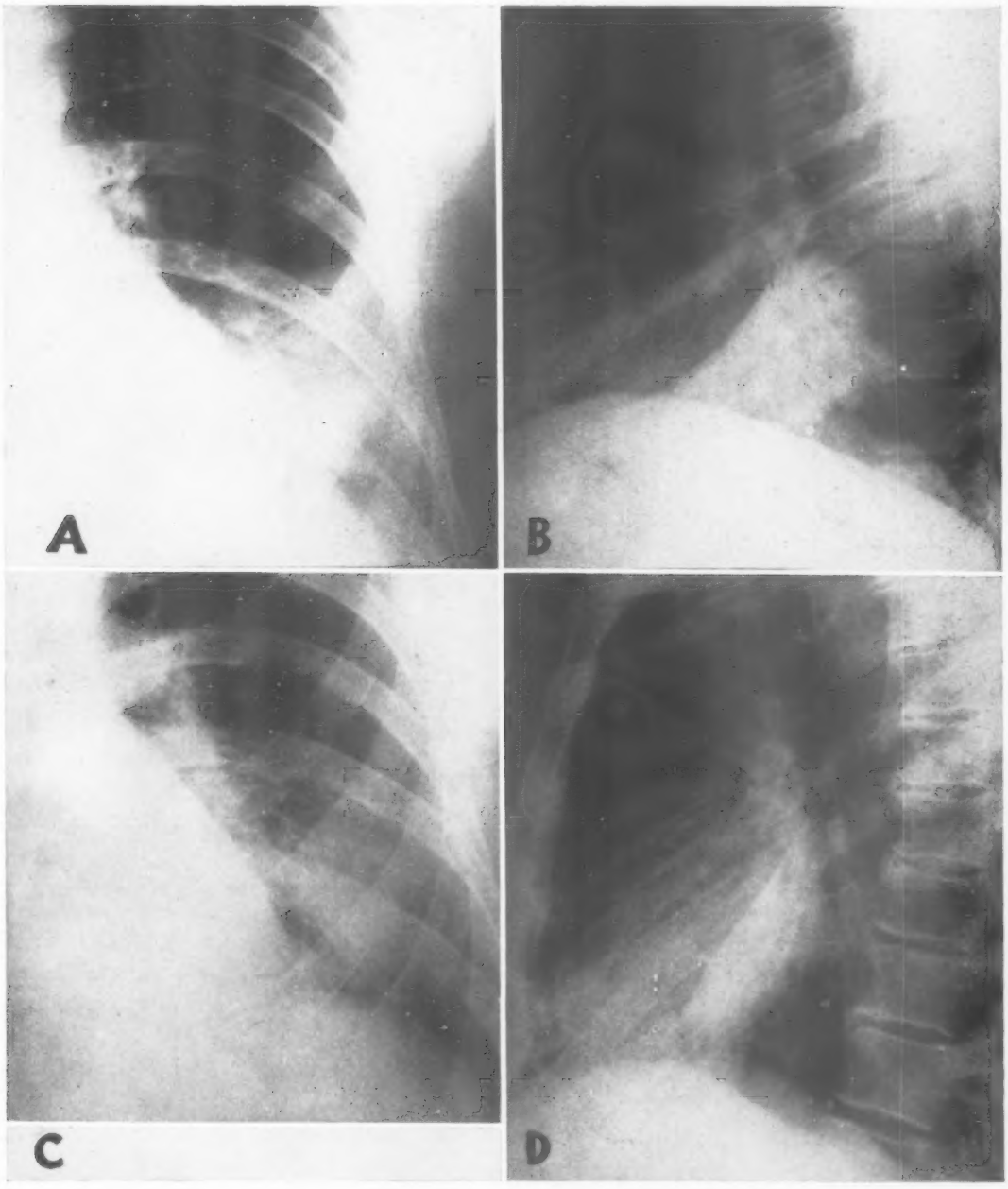

Fig. 17. (*A*) Consolidation of left anteromedial basal segment in a patient with pneumonia. (*B*) Lateral roentgenogram of (*A*). Note wide band-like density with anterior margin formed by oblique fissure and sharply defined posterior border. (*C*) Posteroanterior roentgenogram showing collapse of left anteromedial segment. Note patchy density in lateral portion of lower lung field. (*D*) Lateral view of (*C*) showing narrow band-like density with sharply defined anterior border and poorly defined posterior border.

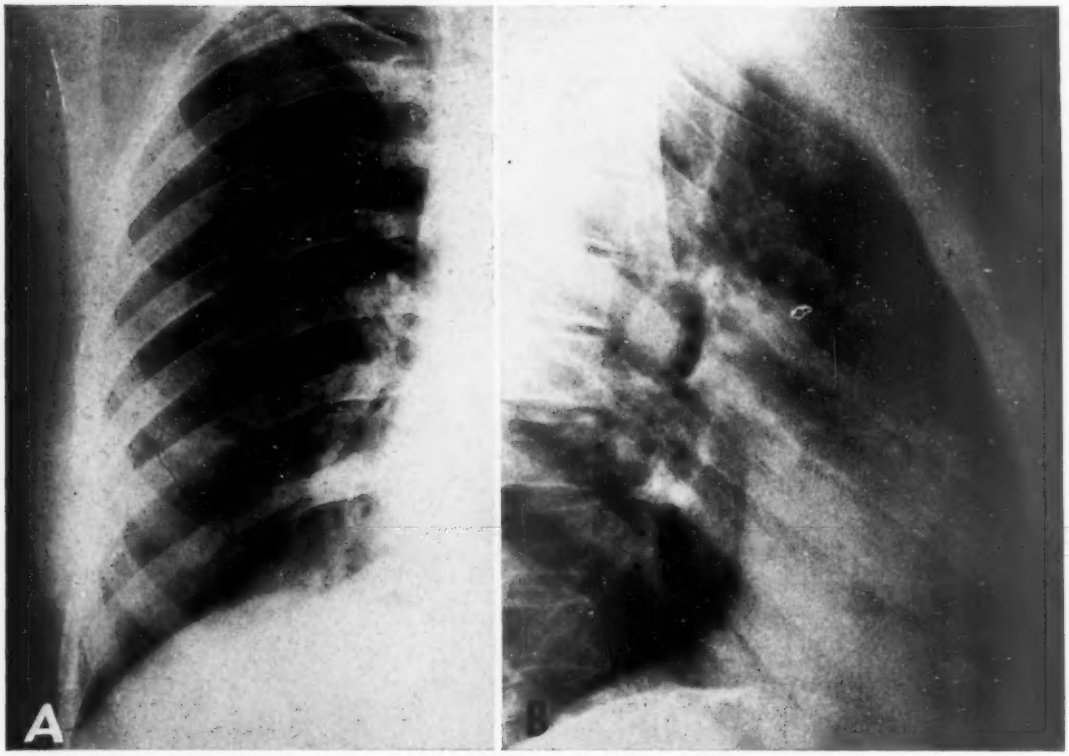

FIG. 18. (*A*) Pneumonic consolidation of right medial basal segment. (*B*) Lateral roentgenogram of (*A*); note its triangular shape with the base resting on the diaphragm just posterior to the mid-portion and the apex pointing to the hilum.

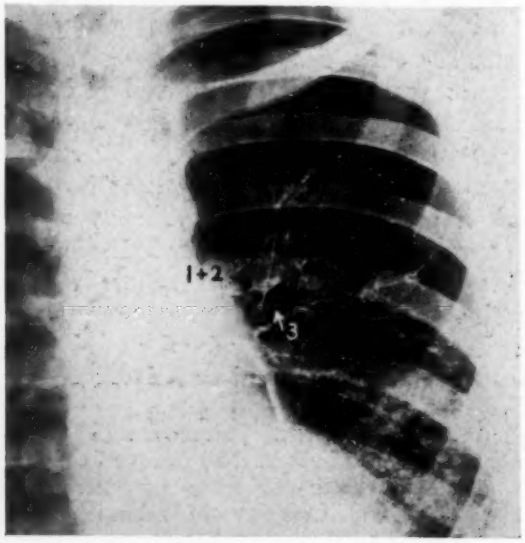

FIG. 19. Bronchogram illustrating the bifurcation of the primary bronchus supplying the upper division (upper lobe proper) of the left upper lobe into apical posterior (*1+2*) and anterior (*3*) segmental bronchi.

division bronchus divides usually into two major segmental bronchi, anterior and apical-posterior (Fig. 19). The lower division bronchus divides also into two major rami, superior and inferior (Fig. 20). Jackson and Huber[18] pointed out that the terms superior and inferior are preferable to medial and lateral in that the essential relationship is one above the other. The left upper lobe is therefore seen to comprise four major bronchopulmonary segments, anterior and apical-posterior of the upper division or upper lobe proper and superior and inferior of the lower division or lingula.

Upper Division (Upper Lobe Proper).

1–2. *Apical-Posterior Segment.* The apical-posterior segmental bronchus supplying this segment divides into two major branches, apical and posterior. The apical branch supplies the medial and anterior portion of the apex and the posterior branch supplies the posterior and lateral apical

regions. Consolidation of this segment, since it is the equivalent of the apical and posterior segments of the right lung, is seen in the posteroanterior roentgenogram as a large homogeneous density, obscuring the apex of the lung above the circle of the first rib and extending down to the hilum (Fig. 21). The outer border from about the level of the first rib at the periphery extends down to the level of the sixth or seveth rib posteriorly and then slopes obliquely inward in a fairly striaght line to the hilum. In the lateral projection the shadow is seen to occupy the apex and posterior parts of the upper chest and to be superimposed by the shadow of the shoulder girdle (Fig. 21*B*). The posteroinferior margin is sharply delimited by the upper half of the oblique fissure.

Collapse of this segment usually presents a less well defined density on the posteroanterior projection than that seen in consolidation and there is frequently a concavity of the lateral border. In the

Fig. 20. Lateral bronchogram left upper lobe visualizing lingula and demonstrating superior (upper white arrow) and inferior (lower white arrow) segmental bronchi.

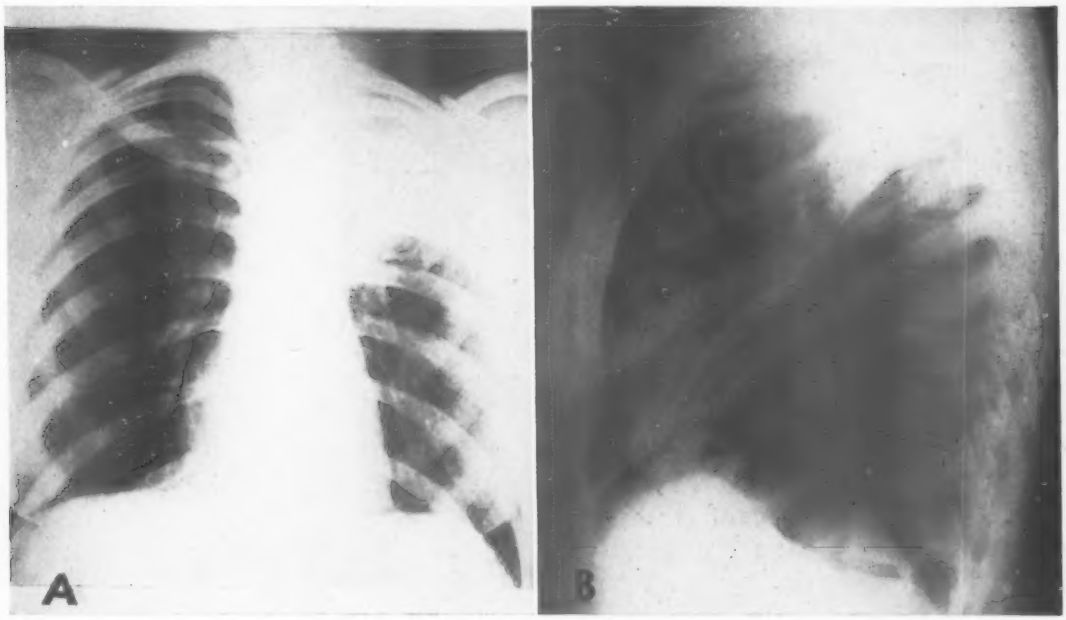

Fig. 21. (*A*) Consolidation of apical posterior segment, left upper lobe, in a patient with pneumonia. Consolidation of this segment, since it is the equivalent of the apical and posterior segments of the right lung, produces a large homogeneous density obscuring the apex of the lung above the circle of the first rib and extending down to the hilum. The lateral border is seen to extend from the first rib at the periphery downward to the level of the sixth rib posteriorly and then slope sharply inward to the hilum. (*B*) Lateral roentgenogram of (*A*). Note that the density occupies the apical and posterior portions of the upper chest. It is triangular in outline with the apex at the hilum. The posteroinferior margin is sharply defined by the posterior part of the oblique fissure.

lateral view, collapse reduces the size of the shadow and simulates somewhat that of a long wedge lying on the superior surface of the upper half of the oblique fissure.

3. *Anterior Segment.* This segment is similar in all respects to its counterpart on the right. The major segmental bronchus, like that on the right, divides into two major rami, anterior and lateral. The lateral branch is said by Brock[9] (1943) to be clinically the most important branch in the left upper lobe since the subsegment supplied by it is as frequently the site of lung abscess as is the posterior segment on the right.

The roentgenographic features of this segment are similar to what has been described for the corresponding segment on the right, except for two rather minor differences. In consolidation and collapse the lower border is usually less clearly defined owing to the absence of a transverse fissure and this segment more commonly extends farther posteriorly than that on the right (Fig. 22*A–B*).

Lower Division—Lingula. Since the lingula represents the equivalent of the left middle lobe, what has been said concerning the right middle lobe applies in general to the lingula. The absence of the transverse fissure on this side renders more difficult the demonstration of segmental pathological processes in this lobe. Foster-Carter and Hoyle[16] state that in their experience proved examples of segmental lesions in this lobe are uncommon. Robbins and Hale[25] feel that segmental pathology of the lingula occurs not infrequently but is difficult to demonstrate. In our experience segmental disease of the lingula is uncommon and very difficult to demonstrate (Fig. 23*A, B, C, D*).

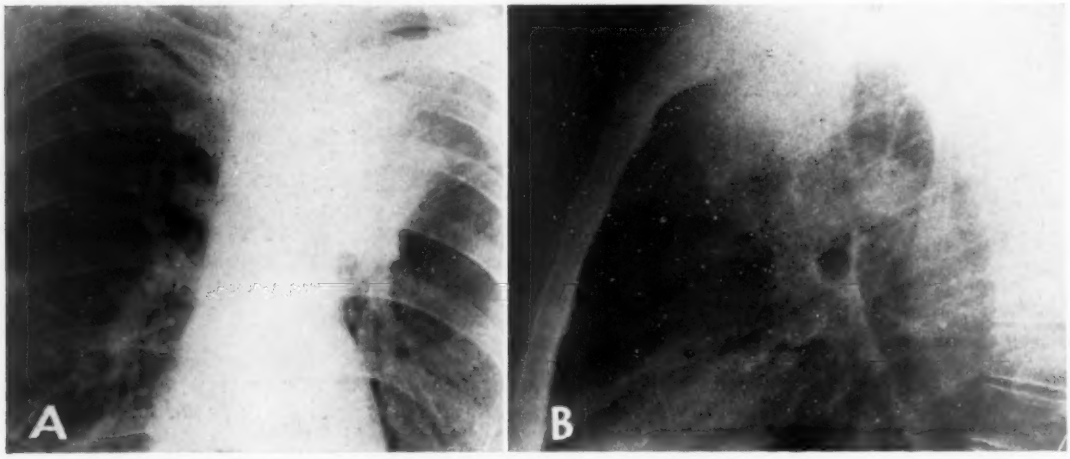

FIG. 22. (*A*) Posteroanterior roentgenogram demonstrating consolidation with some associated atelectasis of anterior segment left upper lobe by bronchogenic carcinoma. (*B*) Lateral view of (*A*) clearly outlines consolidated segment. Slight concavity of lower border indicates some associated collapse.

LEFT LOWER LOBE

This lobe is analogous to the right lower lobe except that the medial basal segment is combined with the anterior basal segment as they share a common bronchus. This combined segment in the Jackson-Huber terminology is called the anterior-medial basal segment. It may be referred to simply as the anterior basal segment. Thus, there are four bronchopulmonary divisions of this lobe instead of the five found on the opposite side (Fig. 1).

SUMMARY

Recent advances and refinements of surgical techniques in segmental pneumonectomy have emphasized the need for the roentgenologist to be thoroughly familiar

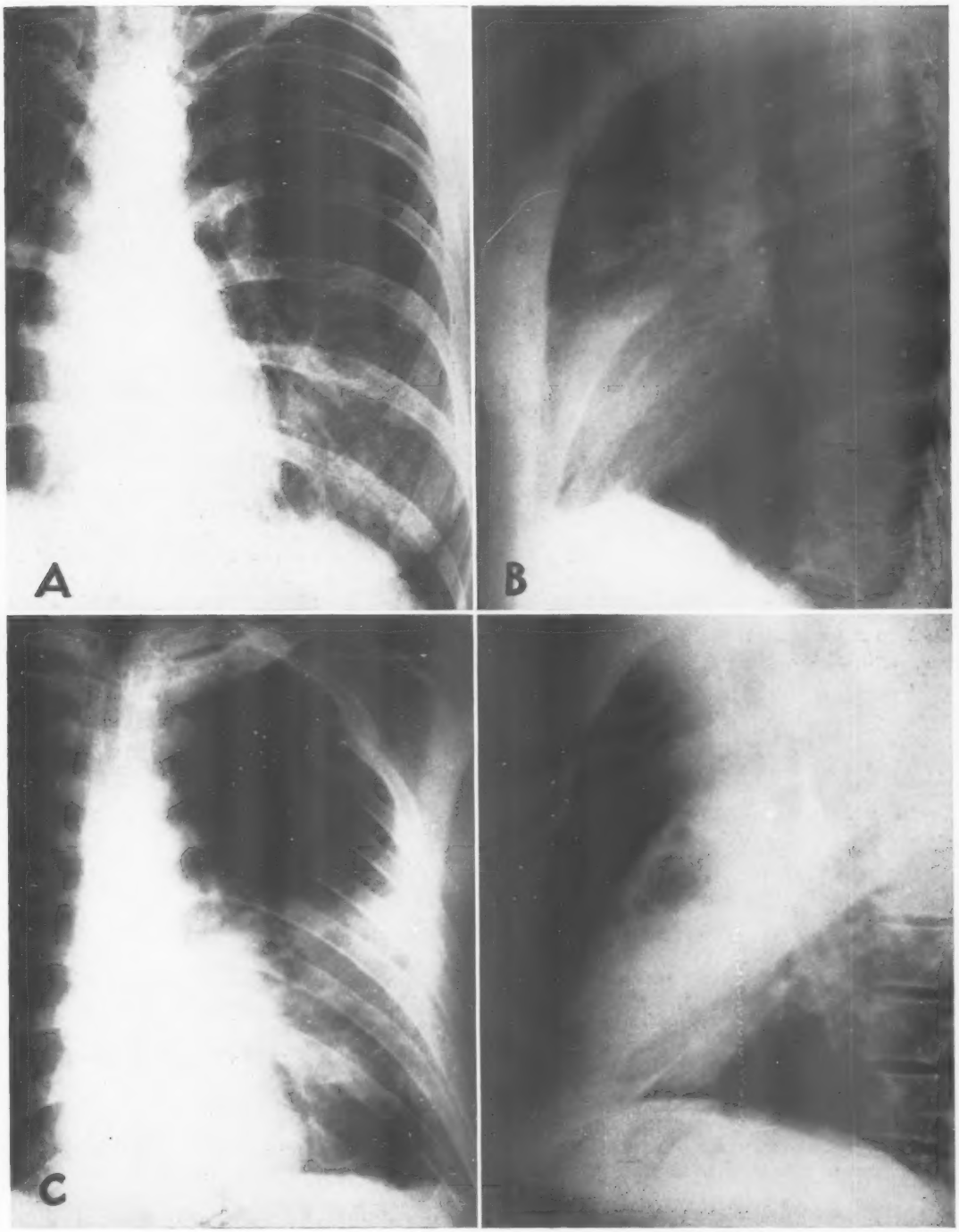

Fig. 23. (*A*) Posteroanterior roentgenogram of patient with virus pneumonia showing segmental consolidation of the lingula. The infiltration does not involve the entire lingula but is limited to the inferior segment. (*B*) Lateral roentgenogram of (*A*) illustrating the parenchymal density lying anterior to the oblique fissure and superimposed on the cardiac shadow. The consolidation is limited to the inferior segment. (*C*) Posteroanterior roentgenogram of proved bronchogenic carcinoma of lingula. Compare with (*A*) and note that in this case the entire lingula is involved. (*D*) Lateral projection of (*C*). Compare with (*B*) where only the inferior segment of the lingula is involved.

with pulmonary segmental anatomy. Frequent variations in the segmentation of the bronchial tree and variations in the individual segments require careful roentgenological studies and close cooperation between bronchoscopist and roentgenologist. The lack of a uniform nomenclature acceptable to roentgenologist, surgeon, internist, bronchoscopist and anatomist has resulted in a certain amount of confusion. It is our opinion that the terminology suggested by Jackson and Huber is best suited to meet the practical needs of the roentgenologist. The anatomy of the bronchial tree and bronchopulmonary segments has been reviewed and the roentgenographic features of pulmonary segmental lesions have been described and illustrated.

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PATHOLOGICAL CONDITION IN AN INFERIOR ACCESSORY LOBE AND ITS PLEURA

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THE presence of the inferior accessory lobe of the lung, which can be recognized on chest roentgenograms, is well known. This has been thoroughly described by Rigler and Erickson.[1] In approximately 10 per cent of normal individuals the lower lobe is divided medially to form an accessory lobe which may be either unilateral or bilateral. On normal chest roentgenograms recognition of this lobe is dependent on the visualization of its interlobar pleura. This appears as a fine linear density extending from the medial portion of the diaphragm obliquely upward and medially

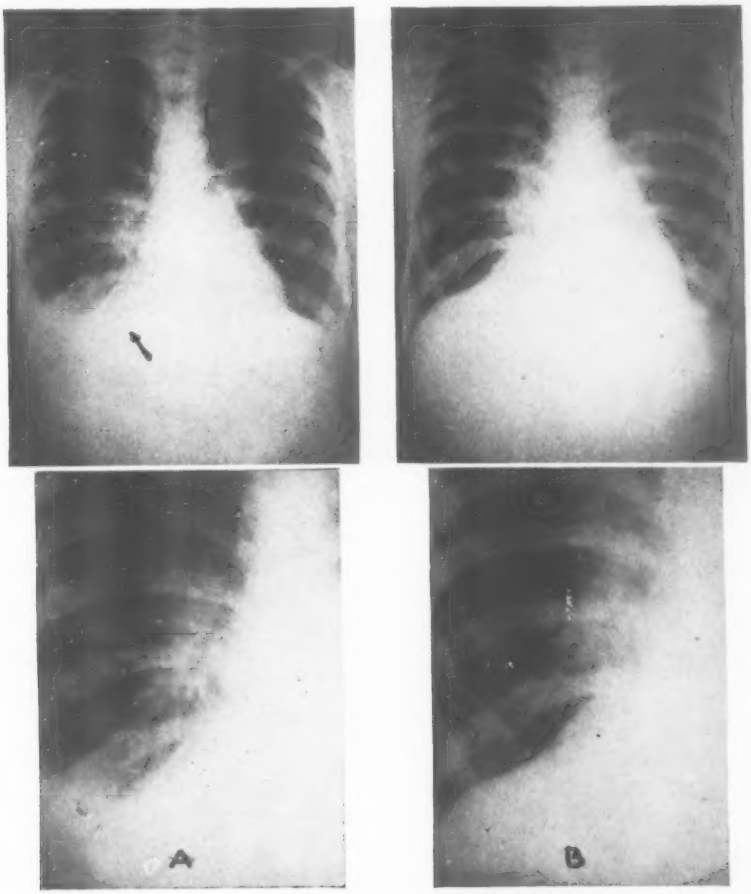

FIG. 1. (*A*) Roentgenogram showing pulmonary congestion, bilateral hydrothorax, elevation of diaphragm due to hepatomegaly, cardiac enlargement, and congestion of right inferior accessory lobe with pleuritis and effusion of its interlobar pleura (arrow). (*B*) Roentgenogram showing progression of changes involving the inferior accessory lobe, which is now seen as a roughly triangular area of uniformly increased density in the cardiophrenic angle on the right. At this stage it simulates a tumor mass or an encapsulated effusion.

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† Section on Pediatrics.

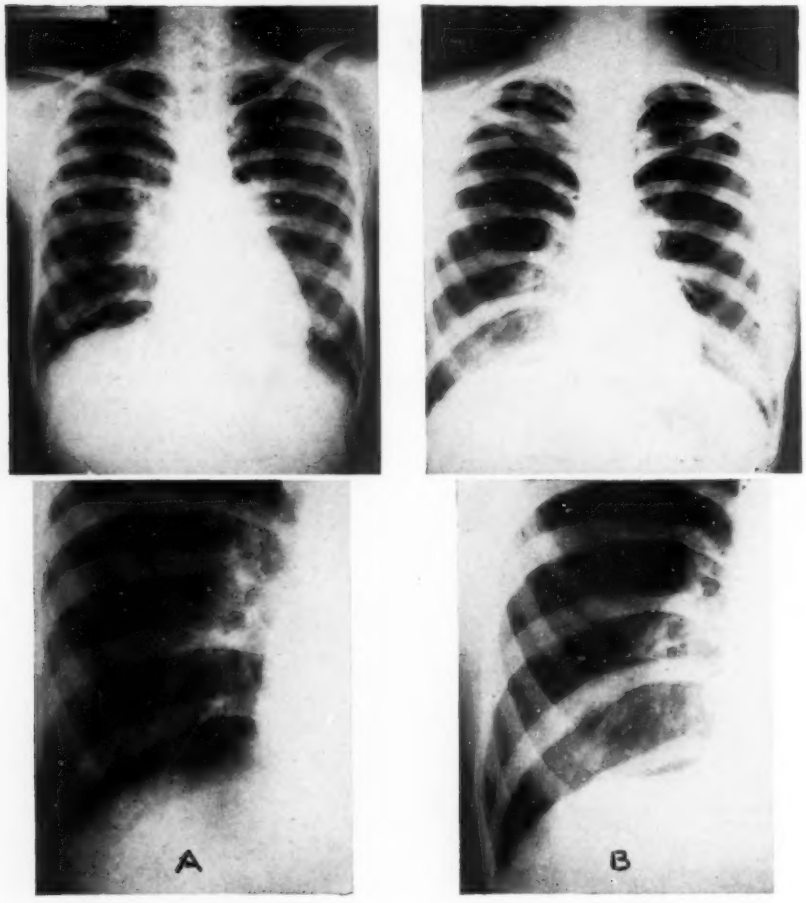

FIG. 2. (*A*) This roentgenogram was taken when the patient was well on the way to recovery. The only change visible now in connection with the inferior accessory lobe is thickening of its interlobar pleura. (*B*) Roentgenogram made after complete recovery. The chest appears normal. On the original roentgenogram the interlobar pleura for the inferior accessory lobe is visible as a fine hair-line density which cannot be seen on the reproduction. The density over both bases is due to the overlying breast shadows.

toward the hilum of the lung. At the point of origin of the pleura from the diaphragm there is frequently seen a small "diaphragmatic tent" which may be mistaken for an adhesion.

Case reports have appeared in the literature from time to time of pathological processes involving the inferior accessory lobe and its pleura. The following is another such case report. It adds another lesion to consider in the differential diagnosis of densities in the cardiophrenic angle, as recently described by Holt.[2]

CASE REPORT

B. M., a white female, aged eleven, was admitted to the Pediatric Service with a diagnosis of acute glomerulonephritis. Part of the workup in the hospital included a roentgenogram of the chest. This film (Fig. 1*A*) showed pulmonary congestion, small amounts of fluid in both pleural cavities, elevation of the diaphragm due to hepatomegaly, and cardiac enlargement. The pleura of the right inferior accessory lobe was greatly thickened and easily visualized on this film. Between it and the right heart border was a triangular area of irregularly increased density due to congestion in the inferior accessory lobe. A progress chest film made four days later (Fig. 1*B*) showed findings similar to those described previously with the exception of the changes in the right cardiophrenic angle. There now was a uniform triangular area of increased density occupying this angle. The pleura for the inferior accessory

lobe was no longer visible. With the preceding film available the significance of this density was easily understood. It represented a summation of densities due to congestion and edema of the inferior lobe, and the pleuritis with effusion of its pleura. If this film had been the initial one there would have been difficulty in differentiating this density from a tumor mass, or from an encapsulated accumulation of fluid.

As the patient's nephritic condition improved and the anasarca subsided, the chest began to clear (Fig. 2*A*). The density in the cardiophrenic angle disappeared and the thickened interlobar pleura of the accessory lobe was now visualized. A roentgenogram of the chest made after the patient was clinically well (Fig. 2*B*) showed no abnormalities. The interlobar fissure for the inferior accessory lobe was now seen as a fine hair-line density which is not discernible on the reproduction. The cardiac enlargement present on the films made during the acute illness, which was partially due to the high position of the diaphragm and partially due to actual enlargement such as occurs during acute glomerulonephritis, had disappeared by the time this last film was made.

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ROENTGENOGRAPHIC DETECTION OF CORONARY ARTERIOSCLEROSIS

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INTRODUCTION

PROBABLY every roentgenologist practicing in the United States whose work includes roentgen studies of the chests of older people must be examining persons with coronary arteriosclerosis, but many are failing to detect the disease and to report positive findings. It is true that the detection of coronary arteriosclerosis by the roentgen ray does not always mean clinical angina and coronary insufficiency, this being particularly true in the patients of more advanced age. Also it is true that in many patients with clinical coronary sclerosis with confirmatory electrocardiographic findings, the detailed roentgen study fails to reveal positive findings. However, the reverse is also true: there may be clinical and roentgenological agreement of coronary arteriosclerosis and the electrocardiogram may be negative. In these respects, the place of roentgenology in the diagnosis of coronary arteriosclerosis is similar to its place in the diagnosis of old myocardial infarction; it may be confirmatory of clinical or electrocardiographic impressions, or it may be the sole evidence. After having routinely searched during the past three years for coronary arteriosclerosis in all patients over forty years of age referred for roentgen examination of the heart, it is our belief that the examination for this particular pathologic process is best made by high-speed, aimed, multiple spot roentgenograms taken with the rays centered as accurately as possible over the coronary vessels.

The original presentation in the American literature of roentgenologic diagnosis of coronary arteriosclerosis in vivo was made by Wosika and Sosman[13] in 1933. They reported 3 cases, 2 occurring in men and 1 in a woman whose ages were sixty, sixty-seven, and sixty-seven respectively. The female patient had postmortem examination and showed unusually extensive calcification in the left coronary artery and its three main branches and in one branch of the right coronary artery. The same patient also showed marked arteriosclerosis in the aorta and a few calcified nodules in the aortic valve, the latter not being detected antemortem.

Very little has appeared in the literature in the fifteen years following this initial demonstration of the possibilities of direct roentgenologic diagnosis in ante mortem studies. Personal inquiry among roentgenologists practicing in various parts of the country both in hospital and office practice suggests a surprisingly large percentage have never made the diagnosis of coronary arteriosclerosis roentgenologically, although their patient material must certainly have included a number with the pathologic condition. In the belief that coronary arteriosclerosis should be detectable more commonly by roentgenologists and included in the roentgen report, and being in agreement with Sosman[10] that "calcified coronary arteries . . . are mostly not large enough or dense enough to be visualized under the roentgenoscope," we have evolved a technique of routinely searching for coronary arteriosclerosis (suitable also to improve the incidence of detection of lesser degrees of valvular and other intracardiac calcifications) in all patients over forty years of age who are referred for cardiac roentgen study. While the average age in a series of 23 patients seen in the past two and one-half years is sixty-seven years, one-third of the group has been in the fifty to sixty age group. We have not been certain of the identification of any cases in patients under fifty, although we have thought the roentgeno-

TABLE I

CLINICAL, ELECTROCARDIOGRAPHIC AND ROENTGENOLOGIC CORRELATION—
ELEVEN CASES OF CORONARY ARTERIOSCLEROSIS

Case No.	Name	Age	Sex	Clinical	Electrocardiogram	Roentgenographic Evidence of Coronary Sclerosis	Roentgenoscopic Visualization	Sclerotic Aorta	Heart Size (Hodges-Eyster)	Abnormal Heart Pulsations
40380	A.L.	57	M	Mild angina	Slight peaking CF 2-3-4.	Left coronary	Not sure	Limited	Normal	None
39871	E.V.	71	M	Hemoptysis, precordial pain, dyspnea, left neck and left lower dorsal pain	Abnormal T waves lead-1 and precordial	Left coronary, marked	Positive	Marked	Normal	None
39845	B.R.	46–56	M	?Pseudo angina. No abnormal physical	Negative	Sclerosis descending branch left coronary now, not 10 yr. ago	Negative	Limited	Normal	None
39211	G.E.	65–70	F	April, 1944, definite coronary occlusion	Infarction anterolateral revealed in 1942 examination	Left coronary	Negative	Limited	Slight enlargement following occlusions	Suggests basal location of infarction
38855	L.E.	57–59	M	Angina, coronary insufficiency. Nitroglycerin relief	Interpreted as showing "coronary insufficiency"	Left coronary	Negative	Limited	Normal	Low splintered waves laterally at apex
38516	S.C.	63	F	Mild dyspnea climbing, slight ankle edema, chiefly gastrointestinal	Prolonged P-R interval and ST-1 change, attributable to digitalis medication	Left and right coronary and mammary vessels	Negative	Marked sclerosis	Upper limits of normal	None
38313	C.A.	70	M	Recent angina on excitement	Peaking T waves CF 2-3-4	Left coronary plus ?right coronary	Negative	Not definite	?Minimal enlargement left ventricle	Unusual left ventricle pulsations occurring momentarily plus low amplitude apical beats
37923	H.R.	57	F	Previous known coronary episode 5 months ago	Residuals of old posterior basal infarction	Left coronary	Positive	Not definite	Upper limits of normal	Lagging apical pulsations
33663 37463	C.O.	59	M	Reportedly had coronary occlusion 3 yr. ago. Treated in another hospital		Left coronary	Negative	Marked	Slight enlargement to left, region of ventricle	?old posterior basal infarction
39363	L.E.	64	M	Dyspnea	"Within normal limits"	Left and right coronaries	Positive	Marked	Normal	None
40823	L.I.	59	M	Two "heart attacks," in bed 3 weeks for 2nd one. Returned to work in 8 weeks	T-2 T-3, Q-2 Q-3 type occlusion 2nd attack	Left coronary	Not sure	Definite	Normal	Absent at apex

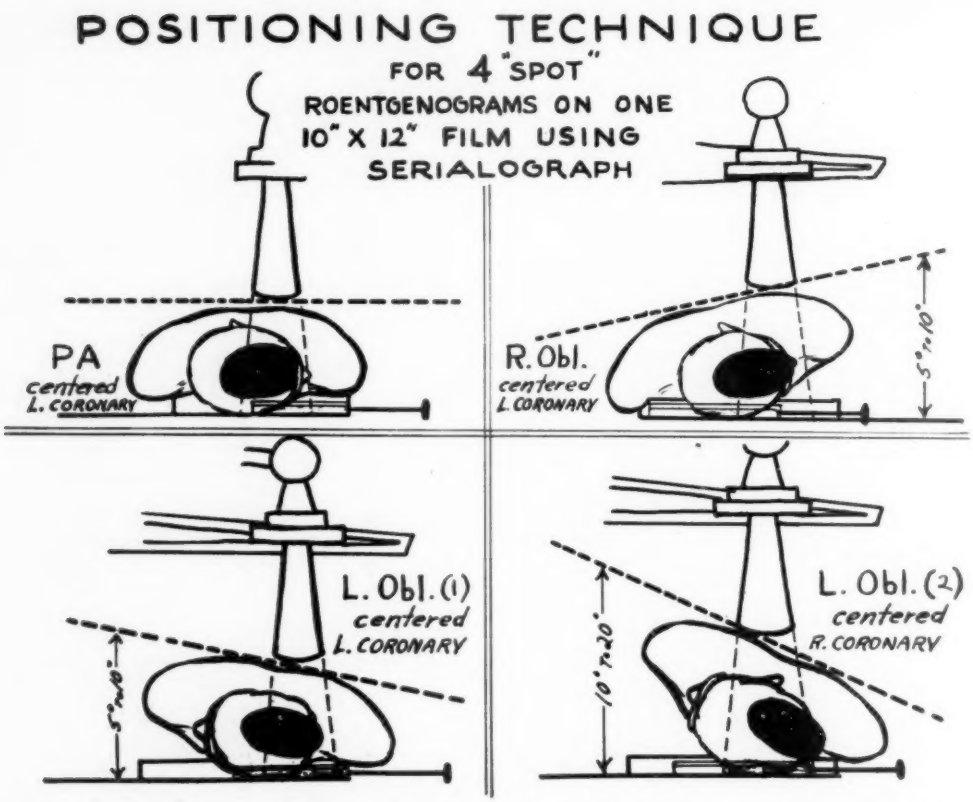

FIG. 1. Positioning technique on serialograph. Centering for position 1 (true posteroanterior) done at close of routine roentgenoscopy and orthodiagraphy. Three inch cone brought down close over posterior chest wall, centered to crayon marking selected roentgenoscopically.

graphic appearances were suggestive (not included in the series herein reported because findings not considered conclusive) in 1 male, aged forty-two, who had clinical evidence of coronary artery disease.

Snellen and Nauta[9] reported a series of 40 cases of coronary calcification detected in vivo, with 5 cases confirmed at postmortem examination and concluded that one should be able to succeed in detecting such a pathological condition with as much ease as detection of calcification of the heart valves, with the possible exception of scattered fleck-form lime precipitates along the vessels. They emphasize that the incidence of more marked degrees of coronary calcification is greater than of calcific changes in the heart valves and state that in a period of one year they had actually detected a larger number of sclerotic coronary vessels than of calcified valves. It is interesting to us to note the emphasis placed on roentgenoscopy by these investigators. They state that in 5 cases it was not possible to show on the roentgenograms with sufficient certainty the calcification established by roentgenoscopy. We are not in agreement with this observation, since approximately half of our cases showing calcification characteristic of the distribution of the left coronary and/or its main branches were not positively identified by roentgenoscopy done carefully, routinely, preliminary to multiple high-speed aimed spot roentgenography. Our experience leads us to the conclusion that careful systematic roentgenographic study done as a routine procedure in patients over the age of forty will reveal certain cases which cannot be seen with certainty roentgenoscopically. These would ordinarily be those patients with lesser degrees of calcification more

finely distributed or in obese or dyspneic patients in whom roentgenoscopy would be less efficient. It should be emphasized, however, that minimal changes in the younger patient may be of graver prognostic significance than marked changes (pipe-stem arteries) in the advanced age groups.

It is recognized and agreed that different examiners are probably possessed of different keenness of roentgenoscopic vision which may explain a larger percentage of roentgenoscopic detections in the hands of one examiner than in the hands of another. There is, furthermore, the matter of roentgenoscopic technique. The use of a very small opening of the diaphragm with small localizing cone attached to the screen with, of course, perfect preparation of the eyes and perfect darkening of the room and the use of the new B-2 Patterson screen which affords 40 per cent more brilliance, will make for increased success of detection of lesser degrees of coronary arteriosclerosis just as it will permit detection roentgenoscopically of small pulmonary lesions and the more shallow wall ulcers of the stomach and duodenum.

ANATOMY

Anatomically it is well established that there is considerable variation in the coronary pattern of different individuals and marked changes occur in the amount and manner of blood flow through the coronary circulation in the same individual during the successive decades of his existence. In the upper age groups, as shown by Wearn,[11] the thebesian vessels (which connect the coronary vessels directly with the chambers of the auricles and ventricles) play an important part in maintaining adequate flow to the capillary bed from the larger coronary vessels. Schlesinger[8] believes the coronary pattern is an important factor in

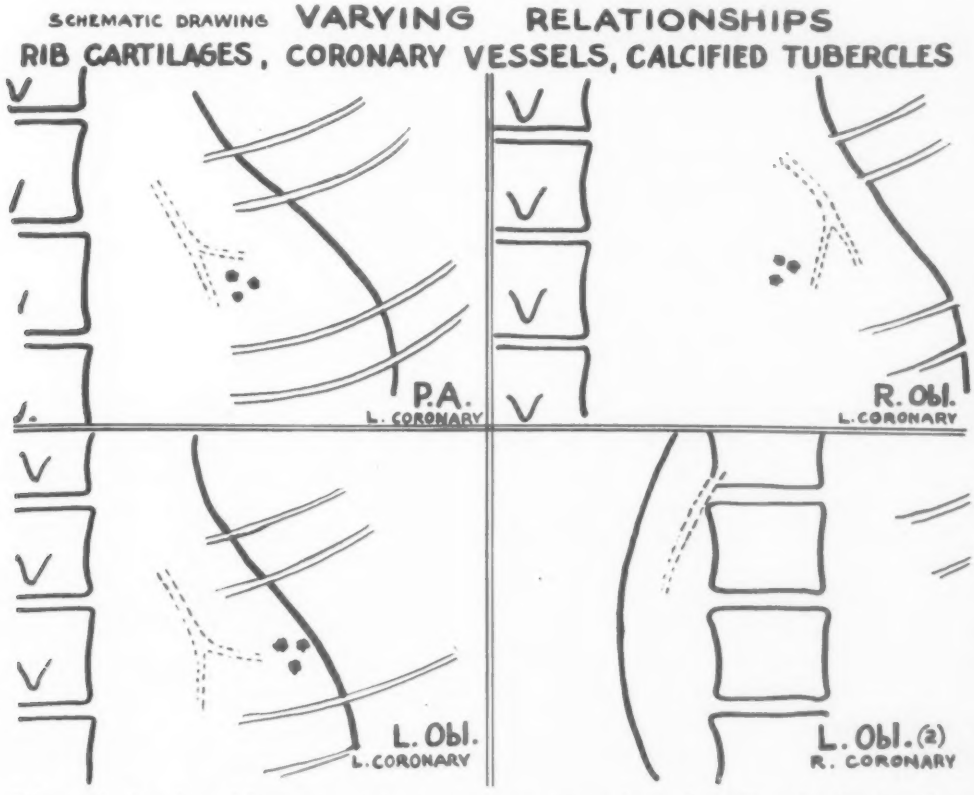

Fig. 2. Schematic drawing of four spot roentgenograms on one 10 by 12 inch film, showing varying relationships of calcified coronary artery, anterior ends fourth and fifth ribs, and calcified tubercles posterior to heart.

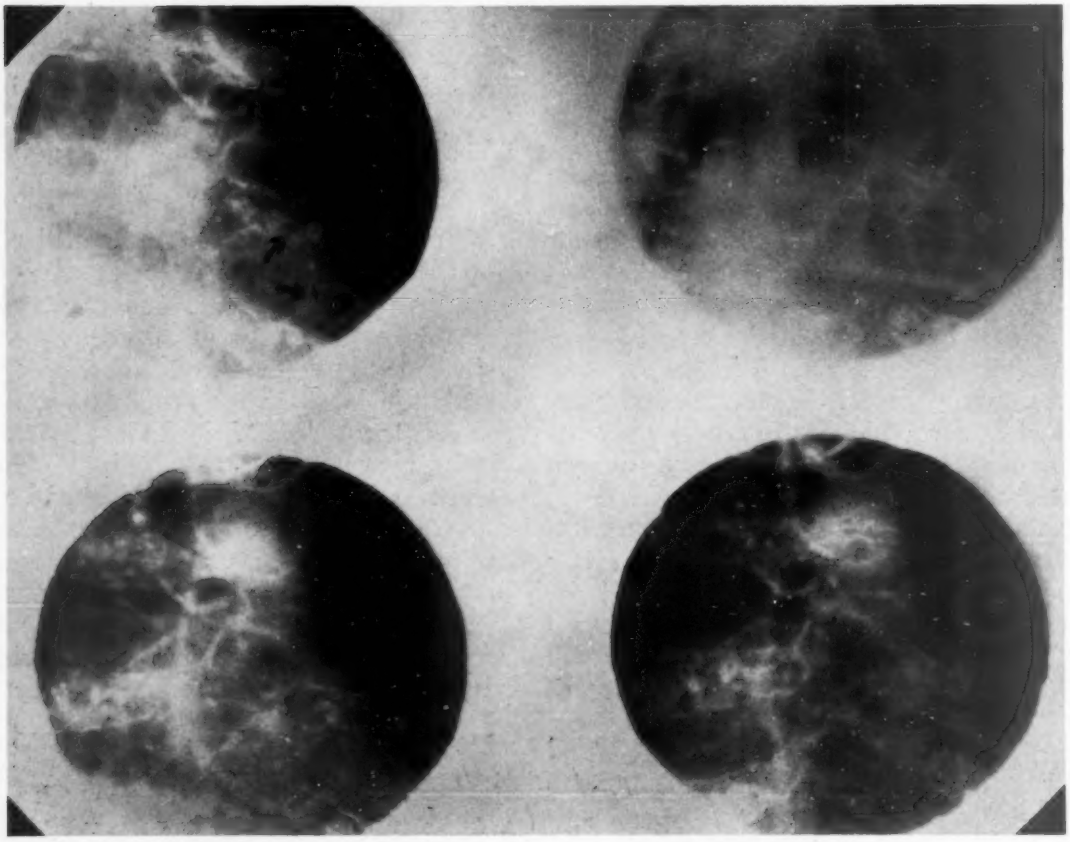

FIG. 3. Left coronary sclerosis including circumflex and anterior descending branches, showing value of *multiple* spot roentgenograms for vessel identification, with patient's position varied from exposure to exposure. Calcification in costosternal cartilages, bronchial walls, and pulmonary tubercles to be differentiated from sclerosis of coronary vessel. Roentgenoscopically: impression of left coronary calcification with very minimal excursion. Female, aged eighty-two.

prognosis when coronary occlusions occur. According to his studies the most favorable pattern is one with no preponderance of either the left or right coronary arteries, the next most favorable is that wherein the right is preponderant over the left, while the least favorable is that with the left preponderant over the right. The patient with the rarely occurring instance of single coronary artery would then presumably have a particularly unfavorable prognosis in the presence of an occlusion, while the other rare instance of three main coronary vessels might be looked upon as a circumstance with a more favorable outlook when an occlusion occurs. In view of the above, it may well be pertinent for the roentgenologist to indicate the relative size of the two stem arteries when both are visualized because of their arteriosclerotic changes.

PATHOLOGY

The roentgenologist is well aware of the fact that much of the arteriosclerosis demonstrable roentgenographically occurring particularly in the extremities of older individuals is medial layer calcification of the Mönckeberg type which is not of great importance clinically.[4] On the other hand, it has been emphasized that for all practical considerations sclerosis of the coronary vessels involves the intima, and the term atherosclerosis ("mushy hardness") may be properly applied. This form of sclerosis is, of course, quite prone to the development of thrombus and embolus. The third type of

arteriosclerosis, arteriolar sclerosis, is rare in the heart. Occasionally it is found with more severe grades of coronary atherosclerosis. In a case of arteriolar disease of the heart reported by Lisa and Brown,[6] the hypothesis was advanced that arteriolar changes are directly related to Raynaud's disease, and these changes are causative factors in myocardial degeneration and endocardial fibrosis.

CLINICAL DIAGNOSIS

According to Barnes,[1] the diagnosis of coronary sclerosis requires sound clinical judgment and the capacity to analyze and interpret clinically the patient's symptoms. "The diagnosis has to be made often in the absence of any abnormality on physical examination of the heart, *without any aid from roentgenographic study* and in spite of an electrocardiogram that is completely within normal limits. The prime fact about anginal pain that must never be forgotten is that it is produced by exertion and particularly by walking, especially if walking occurs soon after eating. A second essential is that the pain is abolished a few moments after the patient ceases his exertion." It is appropriate to emphasize here that even in the presence of positive roentgen findings of coronary arteriosclerosis, the same careful clinical evaluation of the patient is necessary, before concluding that clinical symptoms are attributable to coronary sclerosis. In this respect the changes noted roentgenologically might be likened to the pathologic clouding of an intracranial sinus or the evidence of tuberculous disease in the lung—they may or may not be of immediate clinical importance.

White[12] states, "The usual absence of characteristic murmurs of chronic valvular disease, the usual absence of much cardiac enlargement, *the finding of tortuosity of the*

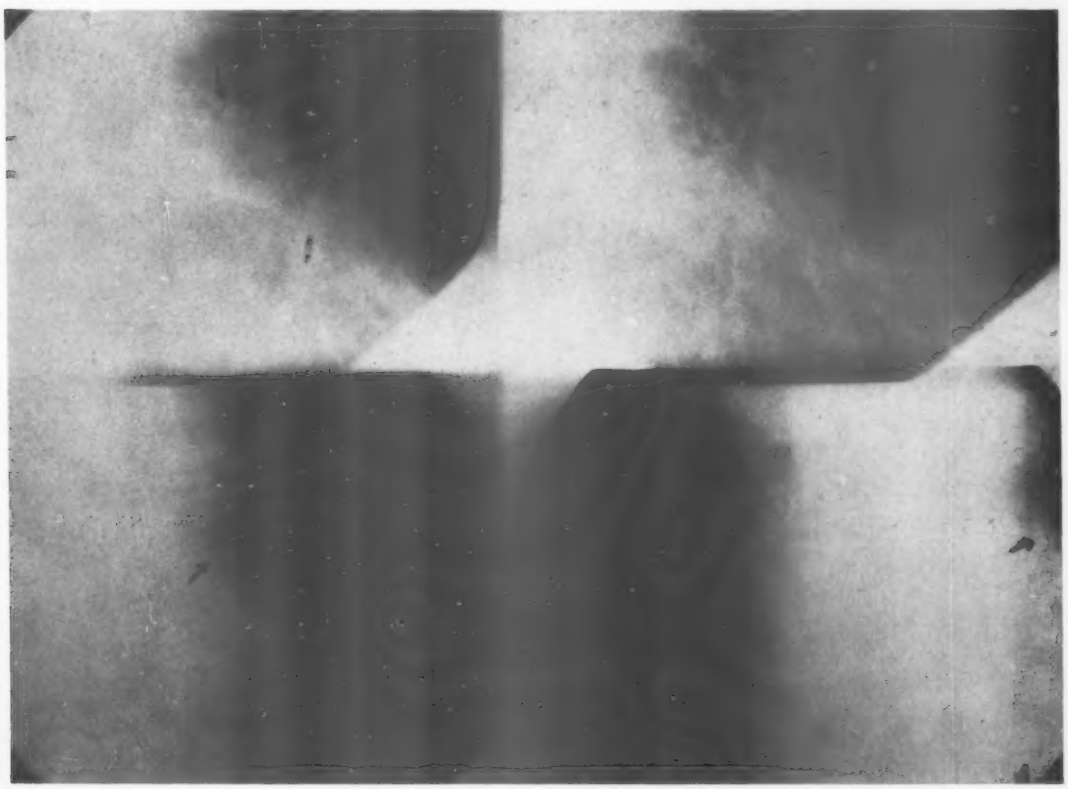

Fig. 4. Left coronary arteriosclerosis, degree insufficient to see positively roentgenoscopically. Multiple aimed roentgenograms, patient's position varying slightly, characteristic tubular form of segmented plaques, form slightly convex upward.

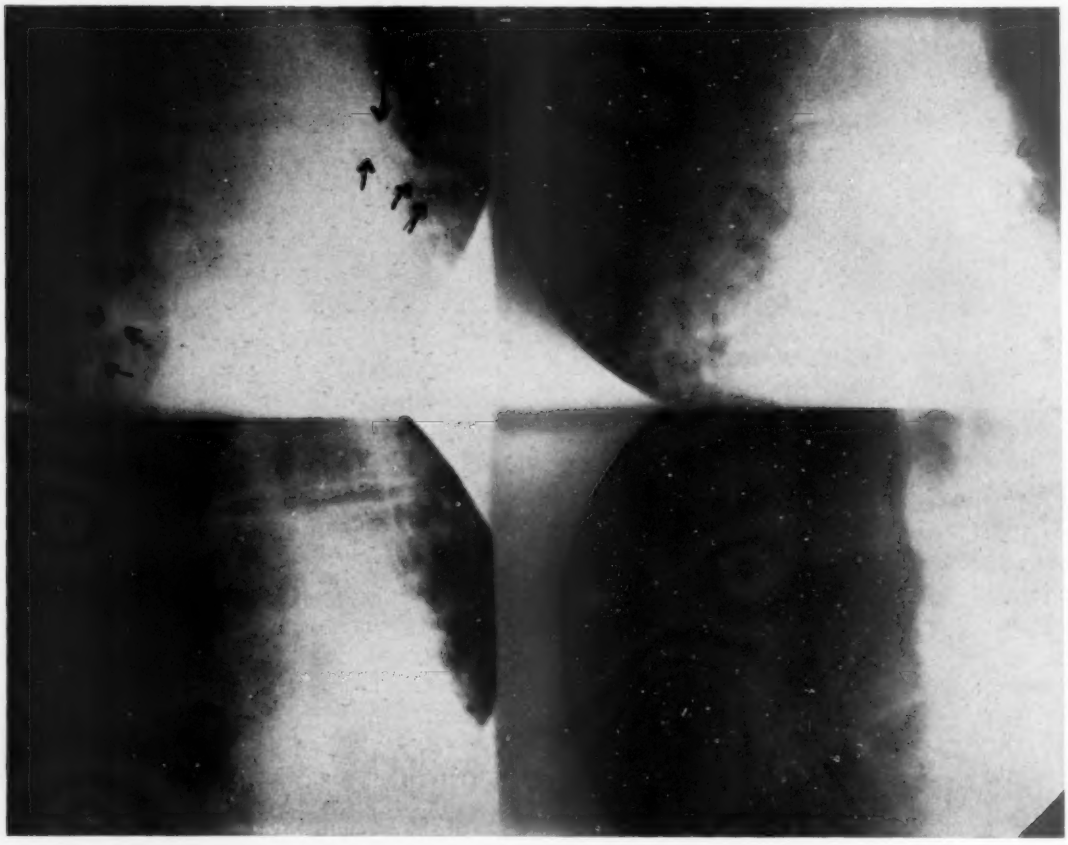

FIG. 5. Multiple aimed spot roentgenograms showing left and right coronary arteriosclerosis, patient aged fifty-nine.

aorta by roentgen ray, and of interventricular block, low voltage or coronary T waves by electrocardiogram, help to establish the correct diagnosis."

Levy, Bruenn and Kurtz,[5] in a consideration of 762 cases of disease of the coronary arteries, found half of the cases to show slight or moderate sclerosis. In many of these no functional impairment of cardiac circulation was induced. Lesser degrees of sclerosis were observed, predominantly in the younger age groups, more marked lesions developing in the advancing years. The increased incidence was particularly noteworthy between the ages of twenty-five and forty-four. Many cases are latent and probably cannot be recognized during life, except by carefully performed roentgenologic examination. That even more marked degrees of sclerosis may at times be present without clinical angina is well established by careful correlation of clinical histories and postmortem studies of the coronary circulation. This has properly prompted the comment by Sosman[13] that "it indicates a specific type of damage in the specific case and can be reported only as such." Arteriosclerotic heart disease was the most frequent primary cause of death. Cardiac insufficiency was the most common terminal event.

Concerning the prevalence of coronary arteriosclerosis in the aged, it need *not* be accepted as inevitable that we shall all have advanced changes if we live to advanced age. Ivy,[3] in a recent discussion of drug therapy in degenerative diseases, quoting postmortem findings observed by Groddeck, noted that 34 per cent of 283 persons over eighty years of age had only *slight*

sclerosis of the *coronaries*, while just 3 per cent had only minimal changes in the *aorta*. Saphir, Priest, Hamburger and Katz,[7] considering distribution of sclerosis in a series of 34 cases, stated, "Sclerotic plaques involving both the right and left arteries were found in 23, in 8 cases the left only was involved, and in 2 cases the right only."

White[12] states that the descending branch of the left coronary near its mouth is the place most commonly affected both by sclerotic change and by thrombosis. Atheromatosis is frequently present in the anterior descending branch of the left coronary artery in the second decade, and regularly in all cases over forty years of age; such changes are found later by about two decades in the right coronary artery and other large branches. Atheroma is, of course, the regular precursor of atherosclerosis.

ETIOLOGY

It is generally agreed that the etiology of atherosclerosis is not known. Recently (June 9, 1947) a new society, The American Society for the Study of Arteriosclerosis, was created. In describing its purposes, Pollak[6] emphasized the chief purpose of the organization to be the *study* of arteriosclerosis in all of its pathologic aspects and clinical manifestations.

Experimental and clinical pathologic observations suggest hypercholesteremia as an important factor in the development of atherosclerosis. Leary[4] believes excess cholesterol in the tissues acts like silica sol in that it promotes the growth of connective tissue. Metabolic disturbances of endocrine origin, particularly thyroid and pancreas, manifested clinically by hypothyroidism and diabetes mellitus, may result in disturbances of lipid metabolism which in turn give rise to hypercholesteremia which is now looked upon as so important in bringing about atheromatosis. Dock[2] believes excessive cholesterol intake in a diet too rich in animal fat, milk and eggs to be an important factor to account for a relatively high incidence of coronary ather-

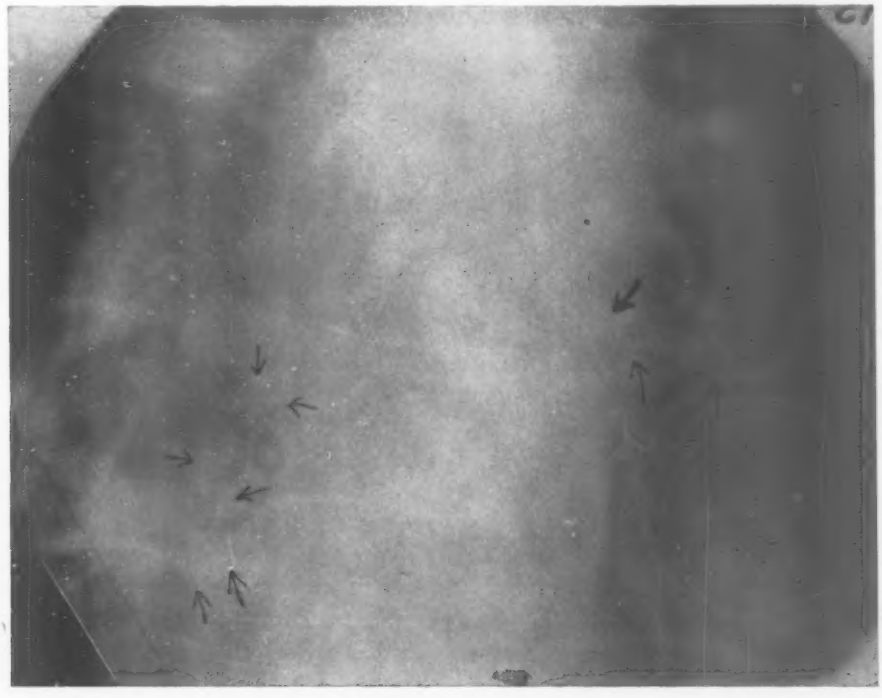

Fig. 6. Magnified view, one of four spot roentgenograms, an instance of left and right coronary arteriosclerosis of a degree which was, in this case, roentgenoscopically visible for the left vessel only.

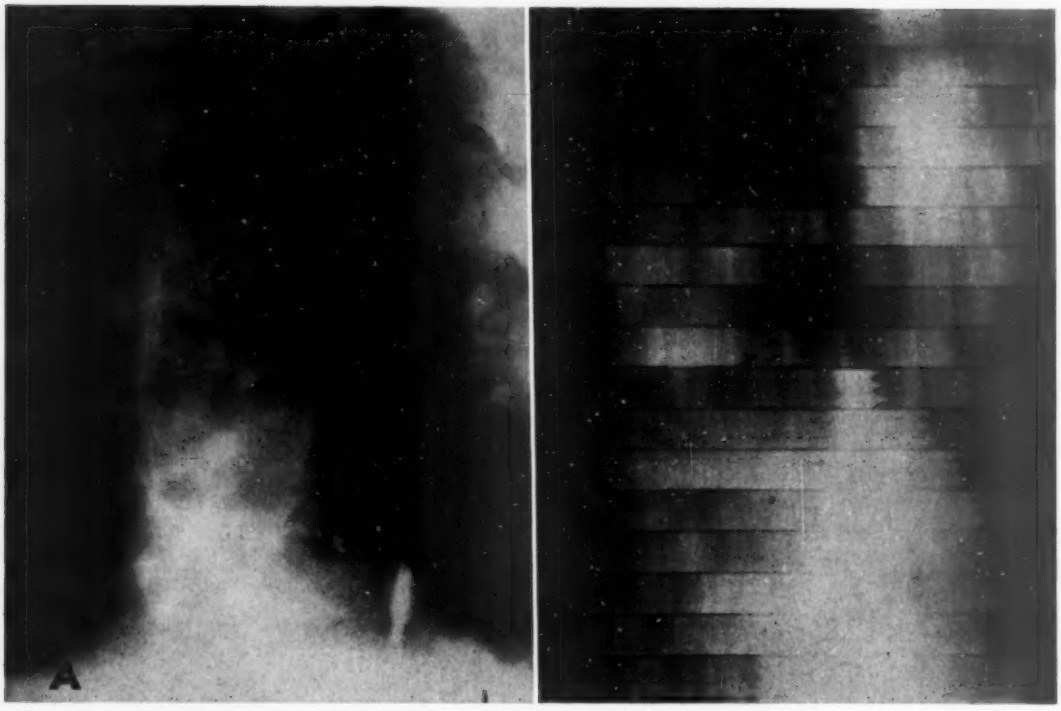

FIG. 7. (*A*) Left oblique 1/30 second exposure left coronary sclerosis, involved segment foreshortened, sclerotic appearance intensified. (*B*) Left oblique kymogram showing excursion of sclerotic vessel.

osclerosis in our people, whereas the Chinese on a high leguminous diet are involved relatively infrequently.

The hereditary factor appears to be an important one both as regards the anatomical coronary pattern and the tendency to intimal thickening in the male sex as contrasted with the female sex, even in the earliest years of life.

ROENTGENOGRAPHIC TECHNIQUE

In our experience with a series of 28 cases observed over a period of approximately two and one-half years, routine *roentgenographic* search will permit detection of a larger group than can be identified by routine searching limited to roentgenoscopy. Sosmán[10] reported a total of 26 cases seen in the Brigham Clinic in a period of ten years, presumably all of these being seen roentgenoscopically. Snellen and Nauta[9] reported a series of 40 cases in 1937 and stated that in 5 it was not possible to show on the roentgenogram with sufficient certainty the calcification seen roentgenoscopically. To us this is a surprising statement since the detailed study of the characteristic curved form of the involved artery, the parallel arrangement of the segmented plaques, and the exact timing of the movement of the area of calcification in relation to the movement of the ventricle borders, requires in our experience careful aimed multiple spot roentgenograms aided at times by posteroanterior and left oblique kymograms. In our experience in the search for arteriosclerotic coronary changes we have occasionally strongly suspected the presence of such disease roentgenoscopically and have not been able to get characteristic densities in the followup roentgenographic studies (finally accepting these as *not* instances of coronary sclerosis). There have been more frequent instances where we could *not* be sure by roentgenoscopy alone that there was intracardiac calcification, while routinely performed spot roentgenograms and kymograms have given positive evidence of the disease.

Our experience in the relative frequency

of left and right coronary artery calcification is similar to that of Snellen and Nauta, the majority of our cases showing left coronary calcification only, with only 4 of the series of 28 cases showing detectable disease in the right coronary. In one of these latter cases the pathologic process appeared much more marked in the right than in the left, while in the other instances the pathologic process appeared about equally marked in the two vessels.

Our established procedure is to do the usual careful roentgenoscopic study including orthodiagraphy in search for any intracardiac calcification (coronary, valvular, septal, annulus, myocardial, pericardial). Following roentgenoscopic study, all patients over forty, regardless of symptoms and roentgenoscopic findings, are examined on a serialograph similar to that used for study of the gastric antrum and duodenal bulb, the patient lying in relaxed prone position (Fig. 1), and a minimum of four roentgenograms are obtained, using a 10 by 12 inch cassette, with a small 3 inch cone being carefully centered, after preliminary marking on the posterior chest wall of the approximate position of the left coronary stem artery while the patient is lying prone on the tunnel. This region is placed as exactly as possible under roentgenoscopic control in the middle of the opening of the serialograph tunnel. It might be further identified as a point about 1 to 2 cm. medial to the left auriculoventricular junction. A small 3 inch cone is used and the tube is brought down so that the cone is in close relationship to the posterior chest wall. Exposures are made at 1/30 second with the milliamperage at 360 and the usual kilovoltage about 60 to 70. The first exposure is made with the patient exactly prone (Fig. 1). The second exposure is made with the patient turned about 5 to 10 degrees into the right oblique position, the third exposure with the patient turned about 5 to 10 degrees into the left oblique position, and the fourth and final exposure with the patient shifted about 1 to 2 inches to the left and turned to about 20 to 30 degrees left oblique, this last exposure being intended to project the region of the right coronary artery in the center of the roentgenographic field (Fig. 2). More effort is made, therefore, to detect coronary artery sclerosis in the left coronary than in the right, because of the known greater incidence of pathology in the left, such pathologic process being usually in more advanced stage of development in the left coronary artery than in the right (Fig. 3 and 4). If, however, there appears to be calcification of the right coronary seen roentgenoscopically (Fig. 5 and 6), multiple roentgenographic exposures would be made with the patient in the left oblique position in order to bring the right coronary artery a little to the right of the spine and in order to distinguish coronary calcification from calcification in the overlying costal cartilages or underlying intrathoracic tissues. Occasionally in the more marked degrees of calcification of the left coronary artery we have found a characteristic short tubular appearance in the left oblique teleroentgenogram taken at 1/15 second exposure (Fig. 7*A*), and occasionally with the patient in the same position during roentgenoscopy for barium visualization of the esophagus we have demonstrated the sclerotic vessel on a 1/10 second exposure esophagram. The 1/30 second exposure spot film technique is preferable for detection of the finer degrees of coronary sclerosis.

Kymography is valuable in those cases wherein the roentgenoscopic study has been negative or equivocal and when spot dense films leave one somewhat uncertain in the differentiation of minimal coronary calcification from plaques extraneous to the heart (most commonly in the costosternal cartilages). With even only very minimal calcification one can reasonably expect to find this reflected in the kymograms as a fine pencilled movement corresponding quite closely in timing relationship and form to that of the ventricle, and these characteristic appearances may be seen either in the conventional left oblique kymogram or in a posteroanterior kymo-

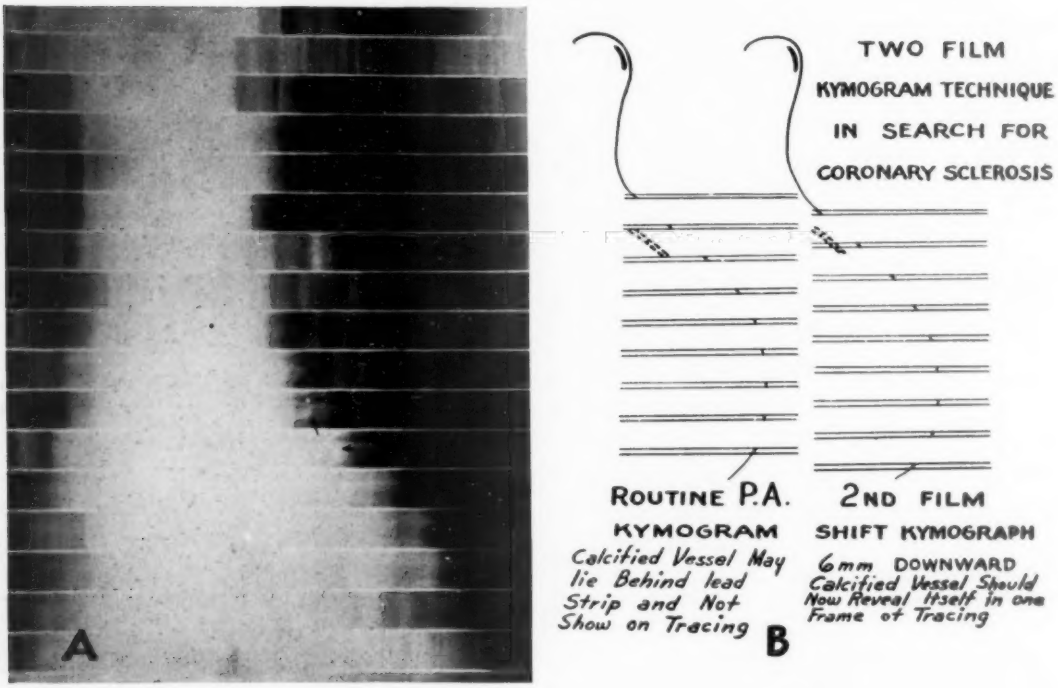

FIG. 8. (*A*) Posteroanterior kymogram shows characteristic excursions of calcified vessel similar in timing relationships and movement to left ventricle border. (*B*) Two-film kymogram technique, occasionally necessary for kymographic confirmation of minimal left coronary calcification. A short segment of sclerotic vessel *might* fall between two openings of multiple slit grid.

gram of slightly heavy exposure in order to "see through" the density of the base of the heart (Fig. 7*B*, 8*A* and *B*). In several patients, not included in this series, the kymograms alone have strongly suggested very minimal calcification moving with the ventricle, located in the usual position of the left and/or right coronary artery wherein the other findings were negative or inconclusive. In the several instances of right coronary calcification which could be readily seen roentgenoscopically, it was observed that the movements of the vessel were timed like the movement of the mitral valve would be, that is, *toward* the apex in systole. From this we would assume that in an instance of marked sclerosis of both coronary vessels which might be seen roentgenoscopically the movements of the two vessels would be toward the midline during systole.

White[12] infers that one may reasonably assume the presence of some coronary sclerosis in an individual with suggestive history and/or electrocardiographic findings who shows by roentgen ray an elongated, tortuous, sclerotic aorta. We have found this to be very true in some of our patients (Fig. 9); that is, marked arteriosclerotic changes in the aortic arch were associated with relatively gross changes in the coronary vessel(s). But we have also had the experience of finding sclerosis in the coronary artery in patients who have shown relatively little evidence of sclerotic changes in the aorta; and again some patients with marked changes in the aorta have shown no detectable coronary sclerosis on most careful roentgenographic searching. We therefore feel that the only reliable roentgenologic basis for interpretation of coronary arteriosclerosis is on the direct evidence of roentgenographic identification, with or without roentgenoscopic confirmation.

As to the relative incidence of the roent-

genologic identification of coronary arteriosclerosis and the identification of sclerotic heart valves, in the period of approximately two and one-half years we have seen 28 instances of coronary arteriosclerosis, and in this same period we have found 12 cases of sclerotic mitral or aortic valves (including the annulus fibrosus). We would therefore agree with Snellen and Nauta[9] that at least in this country (it might conceivably be different in China where the incidence of coronary arteriosclerosis is said to be quite low) one criterion for the care and thoroughness with which cardiac roentgenology is being performed would be the relative incidence of detection of coronary arteriosclerosis to valvular calcification, assuming a practice which includes a representative age distribution. It is fully realized that casual roentgen examination of the heart will result in few if any instances of detection and identification of either coronary arteriosclerosis or calcified valves except in the presence of a most marked pathologic process.

Fig. 9. Marked sclerosis of the aortic arch. Left coronary sclerosis was barely visible roentgenoscopically, identification confirmed on multiple high-speed spot aimed roentgenograms, 1/30 second.

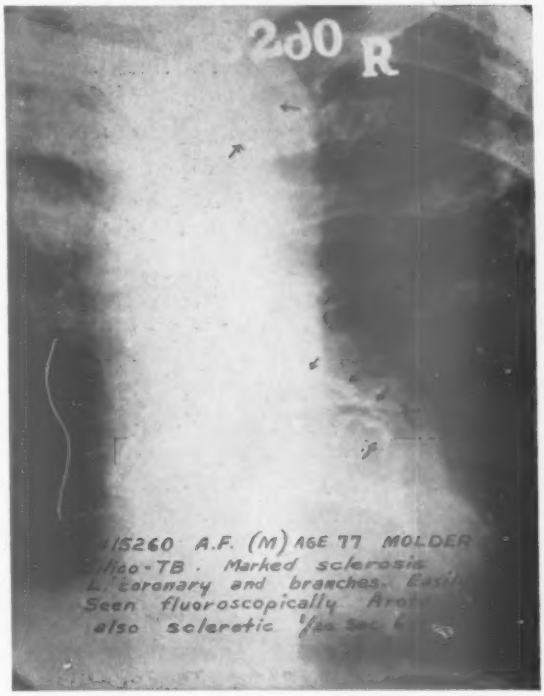

Fig. 10. Marked sclerosis left coronary artery and branches was easily seen roentgenoscopically. Aorta also sclerotic. Teleroentgenogram 1/20 second. This is an example of more marked degree of coronary sclerosis than is usually seen, not difficult to visualize roentgenoscopically and correctly identify. The same holds true for roentgenography, assuming adequate penetration of heart substance. Male foundry molder, aged seventy-seven.

SUMMARY AND CONCLUSIONS

A technique of multiple high-speed aimed spot roentgenography is described which in our experience has permitted detection of coronary arteriosclerosis with a frequency somewhat greater than that of sclerosis of the heart valves. In a period of approximately two and one-half years, during which every cardiac patient over the age of forty received the benefit of multiple spot aimed roentgenograms and kymograms, an incidence of approximately 3 per

cent of coronary arteriosclerosis was demonstrated during which time approximately 1.5 per cent showed sclerotic valves or annuli.

Our youngest patient with well defined coronary arteriosclerosis was a female aged fifty-three. Approximately one-third of the group was in the fifty to sixty year age group.

Based on our experience with the above roentgenographic technique we find nearly twice as many cases of coronary arteriosclerosis as might be found by routine searching with roentgenoscopy only. These cases, pathologic processes of lesser degree, found in the fifty to sixty year age group are probably more important clinically than the advanced degrees of sclerosis seen in the seventy to eighty year age group which may usually be seen and identified by roentgenoscopy. The final evaluation of the *significance* of the roentgen finding of coronary arteriosclerosis must be based on careful clinical considerations.

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REPORT OF A CASE OF RUPTURE OF THE THORACIC AORTA

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A CASE of rupture of an aneurysm of the thoracic aorta with an unusual course and roentgenographic findings is presented.

C. M., a colored female, aged forty-two, was admitted to the New York City Hospital, September 16, 1947, complaining of a dull epigastric ache of three weeks' duration, sudden in onset, transmitted at first to the back and not related to food intake. For the first four days prior to admission, however, there had been vomiting after each meal. Her further history was non-contributory. Venereal history was negative.

Considerable involuntary rigidity of the epigastrium was present, with expression of pain upon palpation. The physical examination was otherwise unremarkable. Temperature was 99° F., pulse 98 and respirations 22 per minute.

A diagnosis of posterior penetrating ulcer of the duodenum was made and the patient transferred to the surgical service. Shortly after admission the icteric index was 13.0, blood urea nitrogen 13.4 and the blood amylase 34 units (normal 20–40).

On September 19, an attempt was made at gastrointestinal examination, but all barium was immediately regurgitated after reaching approximately the middle third of the esophagus. She was in considerable distress and no attempt was made to outline a possible esophageal lesion at the time. A roentgenogram of the chest showed a non-homogeneous area of diminished illumination along the left cardiac border interpreted as representing pneumonic consolidation. The physical signs were said to corroborate this diagnosis. The temperature had risen to 101.8° F., pulse 96 and respirations 24 per minute.

At 7:00 A.M. September 20, the patient was found to be in a shock-like state with generalized abdominal tenderness maximal in the epigastrium and dullness, absent breath sounds and absent vocal fremitus over the right lower chest posteriorly. A roentgenogram showed elevation of the right diaphragmatic dome with an area of homogeneous diminished illumination occupying the lower right lung field. A small amount of pleural effusion was present. The previously noted density in the left lower lung field was noted to be more rounded and homogeneous in nature. A right thoracentesis was performed but no fluid obtained. It was thought that the density in the right lung field might represent an atelectasis secondary to aspiration of vomitus, and a bronchoscopy was performed. An intense redness and swelling of the right main bronchus proximal to the orifice of the right middle lobe bronchus was described, completely occluding the lumen. The area was shrunken with adrenalin and the bronchoscope passed into the distal bronchus, described as normal but for slight dilatation. Throughout this portion of the illness the temperature fluctuated around 99° F., the pulse 110–120 per minute.

Roentgenograms following the bronchoscopy failed to show a significant change in the previously described abnormal densities in both lower lung fields. Epigastric tenderness and resistance continued and the physical findings persistently suggested a right pleural effusion. The patient was returned to the medical service.

A right thoracentesis on September 24, following a roentgenogram of the chest which showed a massive right pleural effusion, yielded only 5 cc. of serosanguineous fluid. The following day 300 cc. of bloody fluid which did not clot was obtained from the right chest.

An esophagram showed that the mass occupying the lower left chest caused a marked anterior displacement of the esophagus (Fig. 1) without evidence of infiltration of its wall. The mass was observed roentgenoscopically at repeated intervals by several observers and was noted to have a definite transmitted pulsation. Opinion varied widely as to the question of an expansile pulsation.

On September 29, 1,100 cc. of brownish fluid was removed from the right pleural cavity by

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thoracentesis. From this date until death the temperature fluctuated between 100–101° F.

Repeated urinalyses showed only a mild pyuria, the Wassermann reaction was 3 plus, the Mazzini test positive, a sickle cell preparation was negative, sedimentation rate (Wintrobe) was 38 mm., hematocrit 34 mm., stool was negative for blood and the chest fluid was sterile on culture.

Blood counts as follows were recorded:

	Hemoglobin	Erythrocytes	Total Leukocytes	Polymorphonuclears	Lymphocytes	Monocytes	Eosinophils
9/18	9 gm.	3.46 M.	8,800	64%	30%	5%	1%
9/20			23,500	85	11	4	
9/22		2.55 M.	13,000	74	24	2	
9/23	7 gm.	2.47 M.	20,000	71	25	4	
9/29	7 gm.	2.37 M.	14,250	70	26	3	
10/2			22,900	80	19	1	
10/8	6.5 gm.	3.2 M.	10,500	76	16	4	

It is noteworthy that the anemia found on admission continued to become more severe during the course of the illness and that on September 20, the day of onset of the acute illness, a moderate leukocytosis developed. The patient was given intensive supportive and antibiotic therapy during the entire course of her illness without an appreciable response.

Following the thoracentesis of September 29, repeated roentgenograms showed a minimal residual right pleural effusion, evidence of thickening of the interlobar fissures and the previously described well circumscribed left posterior mediastinal mass. Kymography in the posteroanterior projection showed only a transmitted pulsation of the mass. Angiocardiography was proposed but could not be carried out because of the patient's critical condition.

FIG. 1. Note the marked anterior deviation of the esophagus by the posterior mediastinal mass.

A thrombophlebitis of the deep and superficial veins of the left arm was noted on October 2, but her condition improved slightly until October 7 when she was again found in acute distress complaining of epigastric pain. Spasm and marked tenderness of the epigastrium were apparent on physical examination.

Throughout the course of the illness opinion varied widely as to the diagnosis and several conditions were considered; among them were aortic aneurysm, peri-esophageal abscess, perforation of a duodenal ulcer with formation of a subphrenic abscess, secondary pleural effusion and mediastinitis. Prior to death several observers noted definite expansile pulsation of the mass and the final clinical diagnosis was aneurysm of the thoracic aorta. The patient died on October 10, 1947.

At postmortem examination the heart was found to be negative, but there was thickening of the wall of the ascending aorta, aortic arch and descending aorta with characteristic "tree-barking" beginning at the arch and extending distally. Many pearly white, soft raised plaques and occasional raised yellow plaques were seen. An aneurysm measuring approximately 5 cm. in diameter was found arising from the anterior wall of the lower portion of the thoracic aorta. The rim of the wall defect was raised. The aneurysm was saccular, the lower pole lying opposite the diaphragmatic vertebral attachment and extending anteriorly and laterally in the

shape of a funnel, the apex at the wall defect. The left lateral bulge was the greatest, the sacs located anteriorly and to the right being smaller in size. No vertebral erosion was present. The aneurysmal wall was lined by well organized and adherent thrombus reaching a maximum thickness of 3 cm. anteriorly. Laterally and posteriorly the wall was thinner with a pinpoint perforation on the right which had allowed blood to extravasate into the right pleural cavity. A similar smaller aneurysm arose from the anterior wall of the abdominal aorta immediately below the diaphragm, extending distally to the mouth of the superior mesenteric artery.

The lumen of the inferior vena cava was completely occluded by a thrombus arising just proximal to the entrance of the inferior vena cava into its hepatic groove and extending distally into the renal, ovarian and common iliac veins. A similar thrombosis of the left subclavian vein was present. Approximately 50 cc. of serosanguineous fluid was in the peritoneal cavity.

The right pleural cavity contained approximately a liter of clotted blood, the majority anterior to a mass of dense adhesions which obliterated the posterior inferior pleural space. The right middle and lower lobes were described as shrunken, rubbery and atelectatic. No lesion of the gastrointestinal tract other than marked anterior deviation of the esophagus around the aneurysm could be found.

Anatomical Diagnoses: (1) Luetic aneurysms of the thoracic and abdominal aorta; (2) right hemothorax secondary to (1) with atelectasis of the right middle and lower lobes; (3) thrombosis of the inferior vena cava, renal veins, ovarian veins and left subclavian vein; (4) hydrohemoperitoneum secondary to (3); (5) luetic aortitis.

The case is presented not only because of the unusual and interesting nature and course of the roentgen findings, but because of the problem encountered in differential diagnosis. In retrospect, the diagnosis of perforation of a thoracic aneurysm may seem self-evident, but at the time the patient was first seen, her findings and symptomatology were such as to suggest a primary lesion of the gastrointestinal tract and the sequelae of perforation. A marked gastric retention was observed, barium being found in the stomach a week after its administration, but without the customary roentgen appearance of pyloric stenosis.

Considerable difficulty was encountered in establishing the presence of expansible pulsation of the aneurysm by customary methods, including kymography. Had angiocardiography been performed the diagnosis could have been established.

The roentgen diagnosis of posterior mediastinal masses in the absence of various signs as wall calcification, tooth rests, bone erosion and/or destruction is primarily a matter of conjecture, subject to the time honored dictum that the spherical, homogeneous, non-erosive mass located in the posterior mediastinum is most commonly of the neuro-fibroma-ganglioneuroma group.

Because of the relative infrequency of large aortic aneurysms in recent years and because aneurysms of the lower descending aorta are only one-tenth as frequent as those of the ascending aorta and aortic arch, the diagnosis of aneurysm of the thoracic aorta is entering less into the differential diagnosis of mediastinal masses. The presence of expansile pulsation as determined on the kymogram or by roentgenoscopy is uncertain. It is felt that only angiocardiography can definitely exclude aortic aneurysm and that aneurysms must always be considered in the differential diagnosis of posterior mediastinal masses.

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ROENTGEN STUDIES OF THE UPPER GASTRO-INTESTINAL TRACT IN VAGOTOMY*†

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THE present phase of peptic ulcer surgery by vagus section represents a revival of an old principle. Dragstedt encouraged this revival by his reports of good results following this form of surgery. Since his initial report in 1943, he and his coworkers and many others have reported progressively larger series of cases. In addition, the subject has been exhaustively reviewed by Moses and by Alvarez, not only from the clinical but also from the experimental and theoretical points of view. In spite of this rather extensive literature, relatively few studies have been made of the results of vagus section from the standpoint of systematic roentgenologic examinations.

Probably the first use of roentgen rays in the evaluation of this problem was in the experimental animal. Cannon in 1910, as credited by Alvarez, utilized this method in studying the physiologic changes induced in vagotomized cats. Subsequently, frequent investigators, using various animals, utilized roentgen rays in recording their postoperative results.

One of the earliest reports emphasizing the use of the roentgen ray in analyzing the postoperative results in man was that of Dragstedt and his group in 1944. Eleven cases of vagus section were studied roentgenoscopically following surgery. Later, in discussing a series of 39 patients, Dragstedt reported that although a decrease in motility of the stomach was found, no evidence was available to suggest such an effect upon the small intestine. Moore *et al.*, in discussing a series of 12 patients, reported a prolongation of the initial and final gastric emptying times. Grimson and his co-workers reporting upon 18 patients found gastric retention and decreased peristalsis with no significant change in three months to one year. A second report by Moore's group on 33 cases noted that the gastric atony was gone in three to nine months, although there might be a persistent delay in pyloric emptying. Johns and Gross reported some degree of motor paralysis of the stomach leading to atony and gastric dilatation in 67 per cent of their 43 cases. They also noted that, in those patients with a gastroenterostomy, the new opening might not be seen roentgenographically during the first month. Collins and Stevenson in a report covering 50 cases found decreased peristalsis and gastric dilatation to be their most frequent findings, but 24 per cent of their cases received no postoperative roentgen followup.

Apparently, the earliest report devoted solely to a roentgen study of the human gastrointestinal tract following vagotomy was that by Ritvo and Shauffer, in 1948. Their study included 33 cases, 9 with postoperative followup longer than six months, 10 up to six months, and 14 up to four months. They were unable to visualize any ulcer craters following surgery. Early, they saw gastric dilatation and atonicity; with this, there was an associated sluggish, ineffectual and arrhythmic peristalsis or this was absent completely. They also reported that both the initial and the absolute gastric emptying times were prolonged and the small intestine was slowed. They found that the above mentioned abnormalities tended to improve within six to twelve months, but observed no case with complete recovery.

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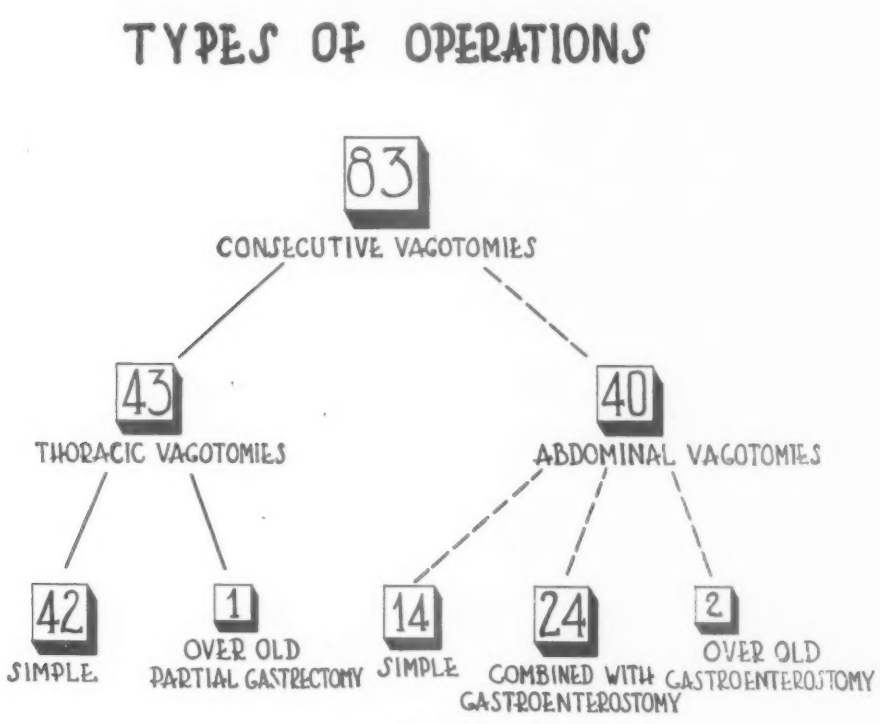

Chart I

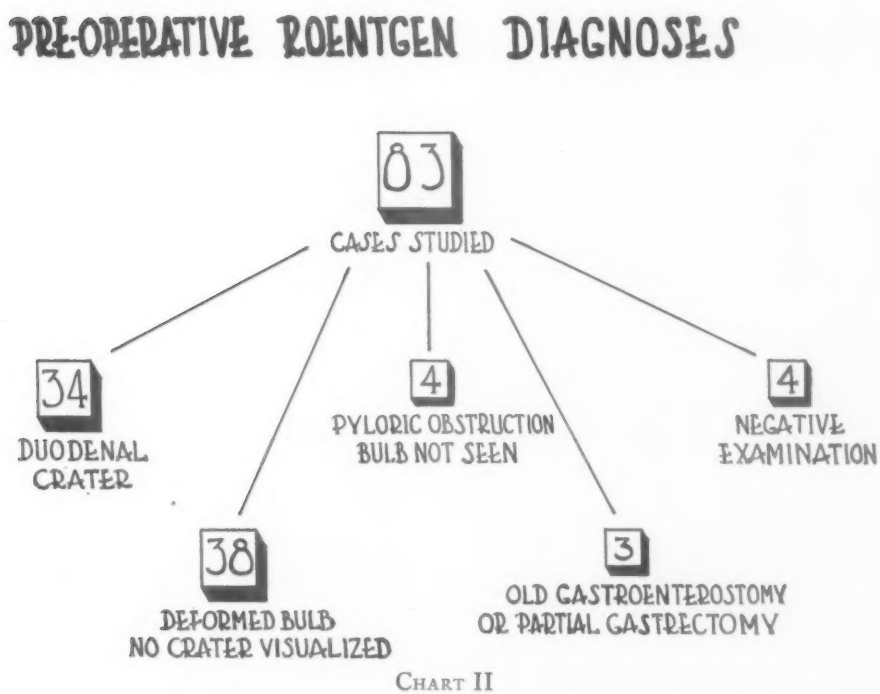

Chart II

Fig. 1. Chart I. Breakdown of cases studied according to whether thoracic or abdominal and whether simple or combined operation. Chart II. Breakdown of results of preoperative roentgen examinations in all cases studied.

MATERIAL AND METHOD OF STUDY

The material for this study consists of 83 patients on whom vagus section was performed at the Birmingham Veterans Administration Hospital between July, 1946, and the end of July, 1947, (Fig. 1, Chart 1). The age limits of the patients ranged from twenty to seventy-two years, with the largest number, one-third of the total, in the fourth decade. Eighteen patients were in the fifth decade, 15 in the sixth, 13 in the third, and 4 in the seventh decade. One patient was seventy-two years old.

Eighty of the 83 patients were male. This preponderance, however, is of no particular significance since the population of this hospital is predominantly male, in approximately the same proportion.

A preoperative roentgen study of the upper gastrointestinal tract was made in every case. Of the 83 patients, 35 showed a definite ulcer crater in the duodenal bulb; 37 had a moderate to marked deformity of the bulb without a demonstrable crater. In 4 the bulb was not seen because of complete, or almost complete, pyloric obstruction. Three had previous gastroenterostomies or subtotal gastrectomies. Four were entirely negative on roentgenological examination (Fig. 1, Chart II).

The postvagotomy followup consisted of examinations made one week, one month three months, and six months after surgery. Of the 83 patients, 75 had a postoperative checkup at one week, 72 at one month, and 50 at six months. The results of the three month examinations were omitted from this study because of the relatively small number of cases in this group, and, more important, because they offered little additional information about the trend of postvagotomy changes.

The roentgen examinations consisted of roentgenoscopy by the staff of the Roentgen Department followed by routine roentgenograms. In addition, two, four and six hour examinations were made and in those cases with a six hour retention, a twenty-four hour examination.

Later in the course of this study all roentgenograms in this series were reviewed by the authors, a total of 345 separate examinations. All changes from the normal were carefully evaluated following strictly established criteria.

The effects of vagotomy were studied upon (1) gastric tone, (2) peristalsis, (3) gastric motility, (4) visualization of the ulcer crater and configuration of the duodenal bulb, and (5) the pattern and motility of the small intestine.

ANALYSIS OF RESULTS

Stomach: The roentgenological changes found in the stomach after vagus section were:

1. Loss of tone with dilatation.
2. Delayed motility.
3. Decreased peristaltic action.

These changes were present whether the operation was performed by the thoracic or the abdominal route and whether it was a simple vagus section or vagotomy combined with gastroenterostomy.

Probably the most striking, although in this series the least constant, change was a loss of gastric tone with dilatation. This varied from a slight hypotonicity with a barely perceptible increase in size to complete atony with extreme dilatation. In the initial phases of the postvagotomy period 43 patients, or 57.4 per cent, exhibited this change. Six months after vagotomy decreased tone was still present in 17 patients, or 33.4 per cent of those examined (Fig. 2 Chart 1). Of these 17 cases, 7 showed some degree of recovery from their initial loss, though still not a complete return to normal. Thus, there were only 10 patients, or 20 per cent, with no appreciable improvement of tone six months after vagotomy.

Delayed motility was a more constant change than loss of tone. This was considered to be present only when a six hour retention was found. In the early postvagotomy period 59, or 80 per cent, of the patients demonstrated this change. Six months after vagotomy, 20 of the 49 patients tabulated, or 41 per cent, still had a six hour retention (Fig. 3, Chart 1). But, as

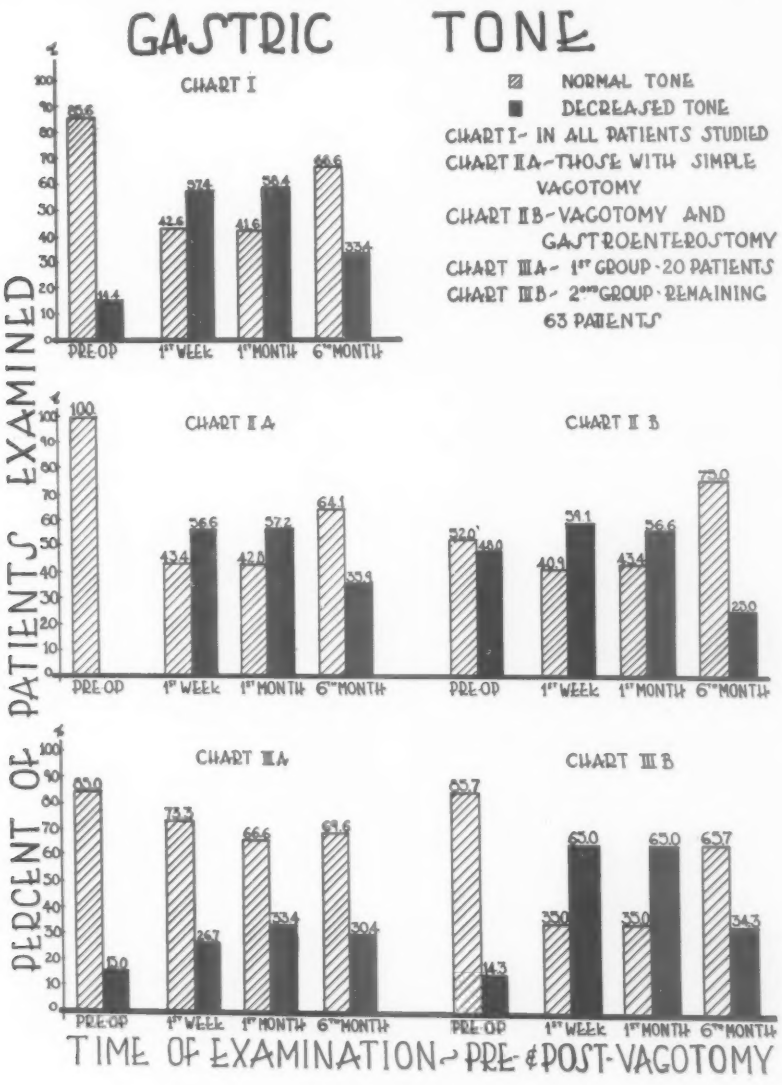

Fig. 2.

in the case of tone, 13 of these 20 patients showed some degree of recovery from their initial delay. Only 7 of the 49 patients, or 15 per cent, revealed no significant improvement of motility at the end of six months.

The most constant of the postvagotomy changes was a decrease of the peristaltic action. This was manifested by either a complete loss of activity, or a decrease in the number and depth of the waves. This change was found in 87 per cent of the cases in the early postoperative period, in 83 per cent at one month, and in 48 per cent at six months (Fig. 4, Chart 1). Here, again, an appreciable trend toward recovery was noted in those that did not return to normal at the end of six months.

A definite correlation was found between the postvagotomy changes and the type of operation, according to whether it was a simple vagotomy or combined with gastroenterostomy. At the end of six months a larger percentage of patients demonstrated a complete return to normal following the combined operation than following simple vagotomy: 75 per cent as compared with 64 per cent in the case of tone (Fig. 2,

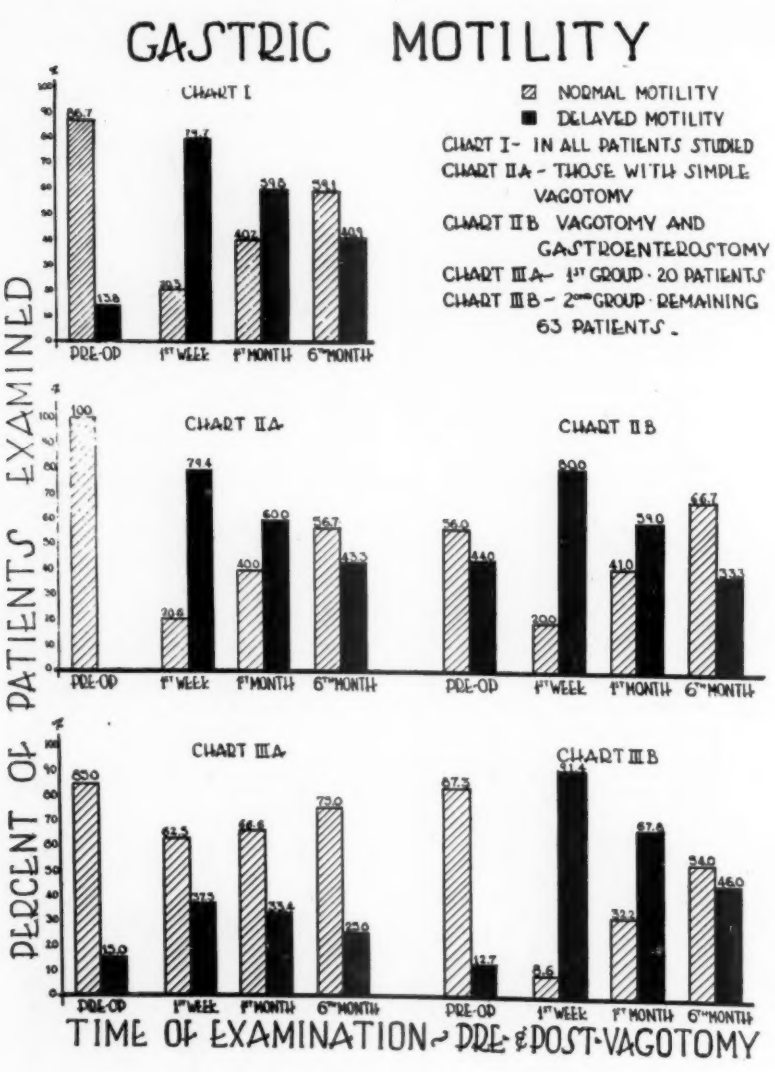

FIG. 3.

Charts II*A* and *B*), and 67 per cent as compared with 57 per cent in the case of motility (Fig. 3, Charts II*A* and *B*).

An interesting feature of the combined operations was that in the early postoperative examinations the gastroenterostomy stoma was seldom observed. The predominant route of emptying in most cases was the pyloric canal. The stoma was usually first seen to function well in the examination one month after operation.

In an effort to determine the value of surgical experience in relation to the results obtained, the 83 cases were divided into two arbitrary groups on a chronological basis. One group included the first 20 operations, the second, the remaining 63. It was found that a substantially larger percentage of patients had demonstrable roentgenological changes in the second group than in the first. One week after vagotomy 65 per cent of the patients had decreased tone in the second group as compared with 26.7 per cent in the first group (Fig. 2, Chart III*A* and *B*); 91.4 per cent exhibited delayed motility in the second group, as compared with only 37.5 per cent in the first group (Fig. 3, Chart III*A* and *B*).

This probably indicates that vagus sec-

tion was more complete in the later months of the procedure and that surgical experience plays a definite role in obtaining complete interruption of the vagus nerve supply to the stomach.

Duodenal Bulb: Of the 35 patients having ulcer crater in the duodenal bulb on preoperative roentgen examination, only 2 had a demonstrable niche one week after vagotomy. This, of course, is of little significance since no compression technique could be employed at this stage of the postoperative period. Furthermore, in many cases, gastric tone and motility were so poor that the duodenal bulb could not be visualized.

What is more significant, however, is that in the later examinations when compression was again freely utilized still relatively few patients revealed the presence of a crater: 5 patients at one month and 7 at six months. All 5 patients who had crater at one month were among the 35 that had a niche before operation. Of the 7 patients, with crater at six months, only 5 had a niche preoperatively; the other 2 had deformity of the duodenal bulb without a demonstrable niche. In these two a crater was demon-

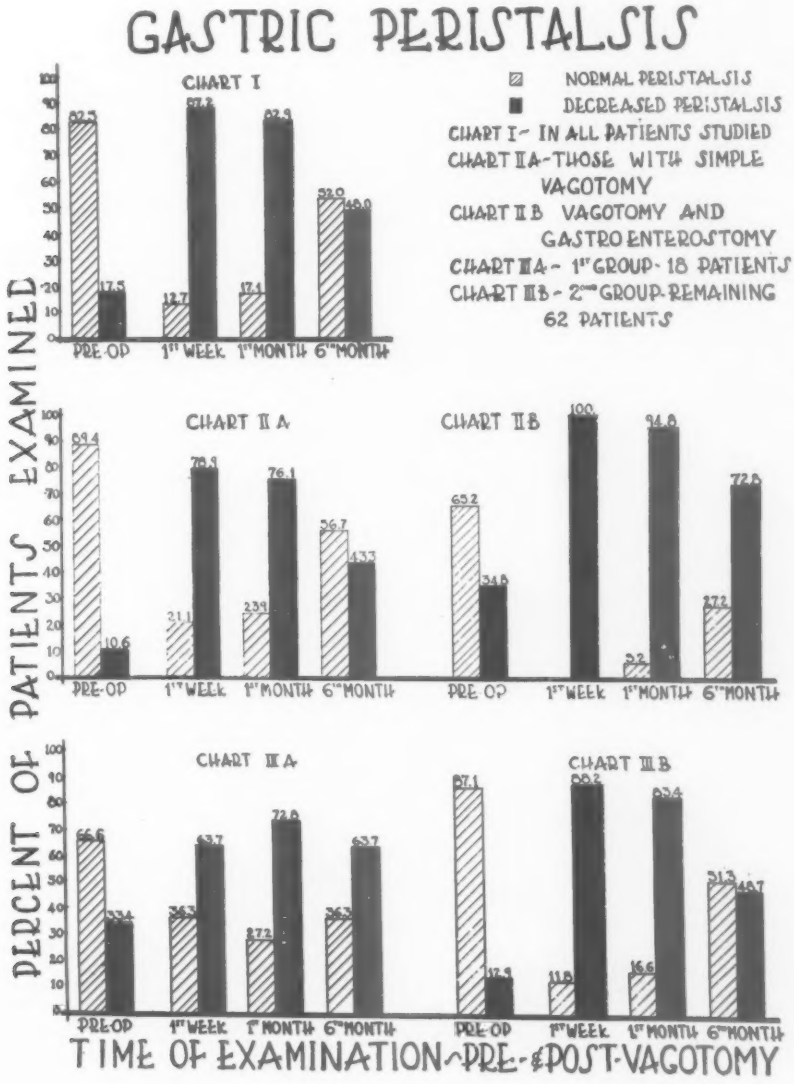
GASTRIC PERISTALSIS
CHART I
NORMAL PERISTALSIS
DECREASED PERISTALSIS
CHART I - IN ALL PATIENTS STUDIED
CHART II A - THOSE WITH SIMPLE VAGOTOMY
CHART II B VAGOTOMY AND GASTRO ENTEROSTOMY
CHART III A - 1ST GROUP - 18 PATIENTS
CHART III B - 2ND GROUP - REMAINING 62 PATIENTS
PERCENT OF PATIENTS EXAMINED
PRE-OP
1ST WEEK
1ST MONTH
6TH MONTH
CHART II A
CHART II B
CHART III A
CHART III B
TIME OF EXAMINATION - PRE- & POST-VAGOTOMY

Fig. 4.

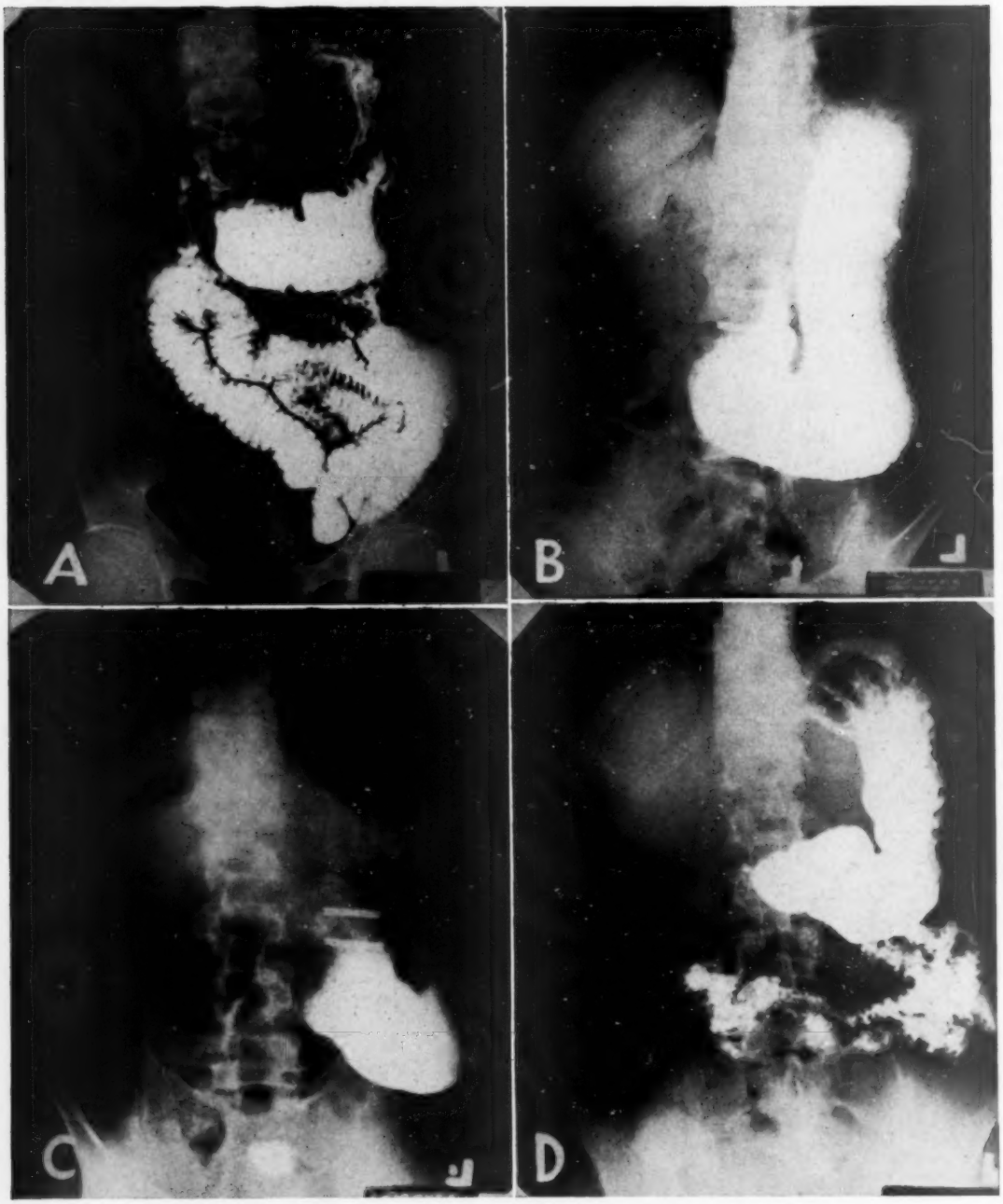

FIG. 5. Ch. W. S. (*A*) Preoperative stomach showing fairly good tone and peristalsis. (*B*) One week postvagotomy. Note complete atony with extreme dilatation. No peristaltic waves are seen. (*C*) Same day; 50 per cent six hour retention. (*D*) Six months postvagotomy. Good recovery of tone and fair peristalsis.

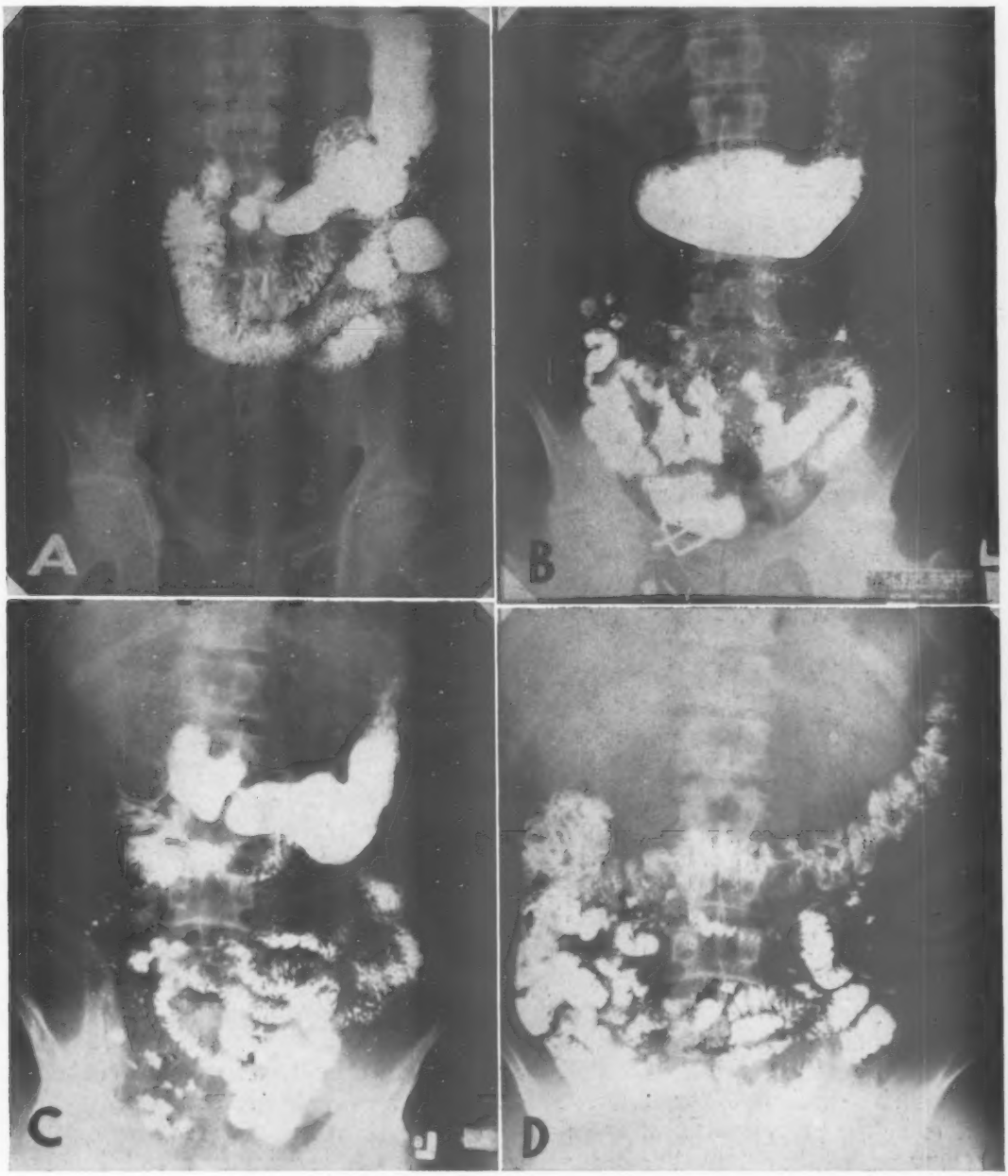

Fig. 6. (*A*) B. E. D. One month postvagotomy. Note marked dilatation of duodenum. Incidentally, stomach shows good tone. (*B*) J. J. Six months postvagotomy. Small intestinal pattern still disturbed, with abnormal segmentation of loops and flocculation of barium. Head of meal has not yet reached cecum at the end of four hours. Incidentally, no recovery of gastric tone and motility. (*C*) R. D. One week postvagotomy. Six hour gastric retention. Also note dilatation of duodenum and delayed motility of small intestine. (*D*) Six months postvagotomy, same patient as in (*C*). Four hour film. Stomach empty, head of meal in splenic flexure; slight segmentation of barium-filled loops still evident.

strated for the first time six months after vagotomy.

It is of considerable interest that 23, or 46 per cent, of the 50 patients examined at six months had an ulcer crater before operation. This compares favorably with the 42 per cent found to have a crater in the entire group studied before surgery.

No definite correlation could be found between changes in tone and motility and the persistence or disappearance of the ulcer crater. Of the 5 patients with a crater at one month, 3 had loss of tone and delayed motility and 1 more had delayed motility without loss of tone. Of the 7 patients with a crater at six months, 2 had decreased tone and delayed motility in the same examination.

The number of those that were found to have a normal bulb is not very striking at any stage of the postvagotomy period up to six months. At one month 13 patients, or 16.6 per cent, had negative duodenal bulbs. Preoperatively, 4 of these had roentgenologically negative bulbs, 7 had ulcer craters, and 2 had duodenal deformity without a niche. At six months, 10 patients, or 20 per cent, were found to have normal bulbs. Preoperatively, only 2 of these had negative bulbs, while 6 had ulcer craters, and 2 more had duodenal deformity with a niche.

Small Intestine: There were definite alterations in the pattern and motility of the small intestine as a result of vagus section. The most significant pattern changes consisted of a moderate dilatation of the second, and often also the third, portion of the duodenum. These changes were remarkably constant in the early stages of the postvagotomy period, but tended to disappear by the end of the sixth month. Less often dilatation of the jejunum with or without dilatation of the ileum was found.

Other, somewhat less constant, alterations of small intestinal pattern included pooling of the meal, segmentation of the opaque filled loops, and flocculation of the barium, somewhat suggestive of the pattern found in deficiency states.

The passage of the meal through the small intestine was consistently delayed not only in the early examinations but six months after vagotomy as well. Whereas in the preoparative examinations the head of the meal almost invariably reached the cecum within two to four hours after ingestion, and often sooner, after vagus section barium seldom appared in the cecum within four hours after leaving the stomach. Comparatively few cases revealed a return to normal in six months, although a slight trend toward improvement was noted in many cases.

SUMMARY AND CONCLUSIONS

1. Eighty-three consecutive cases of vagus section were studied roentgenologically. All had preoperative examinations. The postvagotomy studies included 75 patients at one week, 72 patients at one month, and 50 patients at six months.

2. The changes found in the stomach after vagus section are decreased peristalsis, delayed motility, and loss of tone with dilatation. Of those examined one week after vagotomy, 87 per cent showed decreased peristalsis, 80 per cent delayed motility, and 54 per cent loss of tone.

3. The tendency for these functions is toward gradual improvement. At six months, however, a rather large percentage still did not return to normal: 48 per cent in case of peristalsis, 41 per cent in case of motility, and 33 per cent in case of tone.

4. The changes are found with equal frequency whether the operation has been performed by the thoracic or abdominal route and whether it is simple vagotomy or combined with gastroenterostomy. The tendency to return to normal, however, is greater after the combined operation than after simple vagotomy.

5. A majority of those having demonstrable ulcer crater in the duodenal bulb before operation show a disappearance of the niche after vagotomy. In this series 42 per cent had a crater before operation but only 14 per cent six months after vagotomy.

6. In the small intestine the most constant changes consist of dilatation of the duodenum and delay of the intestinal motility. Less constant alterations of small intestinal pattern include dilatation of the jejunum and ileum, segmentation, pooling and flocculation of the barium.

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BENIGN NON-OBSTRUCTING TUMORS OF THE SMALL INTESTINE

REPORT OF TWO CASES

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IN recent years increasing attention has been paid to the roentgen examination of the small intestine. As a result more and more pathological conditions of the small intestine are being demonstrated. While the incidence of tumors of the small intestine is low, nevertheless an increasing number are being discovered. However, of the total of all of the tumors reported, relatively few have been demonstrated by the preoperative roentgen examination. By far the greater number have been found at operation in patients in whom obstruction of the small intestine was present. It is obvious that in the presence of clinical intestinal obstruction it would be difficult, if not impossible, to demonstrate the presence of tumor by any type of roentgen examination.

In 2 cases studied recently, neither of which had obstruction, a tumor of the small intestine has been successfully demonstrated.

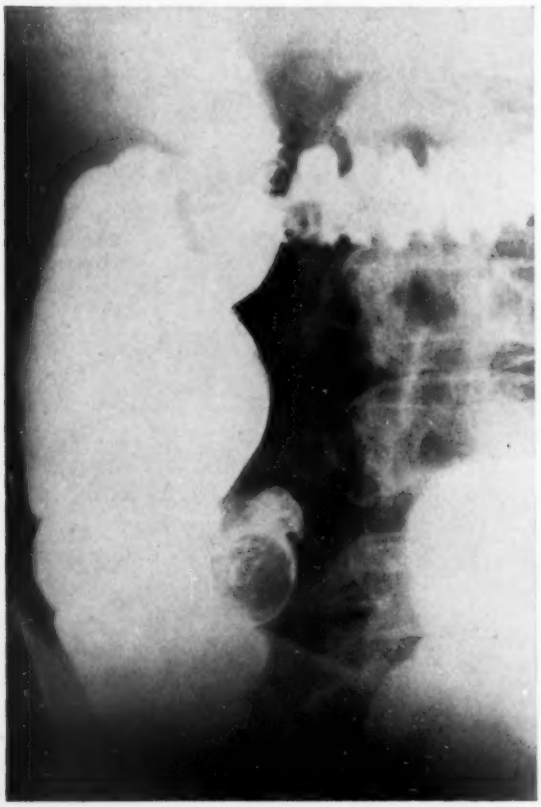

FIG. 1. Barium enema examination showing radiolucent filling defect in terminal ileum.

REPORT OF CASES

CASE 1. C. K., a white male, aged forty, was referred for examination because, on two occasions, the patient had noticed bright red blood in his stool, the first episode having occurred about two years previously. The patient's general health was good and there had been no other symptoms suggestive of gastrointestinal disease. A general symptomatic survey was negative, and on physical examination a few small internal hemorrhoids were the only abnormality noted. Laboratory studies were negative except that occult blood was present in the stool. There was no anemia.

A routine gastrointestinal study demonstrated, in the roentgenograms of both the upper gastrointestinal tract and barium enema, a circumscribed, radiolucent, filling defect in the terminal ileum (Fig. 1), the appearance of which was described as representing an intraluminal tumor. There was no dilatation of the proximal bowel, and no delay in passage of barium into the cecum.

At operation* a tumor was found in the ileum 10 cm. proximal to the ileocecal valve. There was no evidence of infiltration of the bowel wall and no glandular enlargement was noted. A resection of the portion of the ileum containing the tumor was performed and an end-to-end anastomosis made.

The specimen removed at operation (Fig. 2) consisted of a 12 cm. segment of ileum.** Three inches from its distal end there was a soft, yellow, pedunculated, encapsulated tumor protruding into the lumen. The tumor measured 3.5 by 2.5 by 2.5 cm. Microscopic examination showed the typical histopathologic picture of lipoma. The convex surface was covered with

* By Dr. Stephen Ragan, Queen of the Angels Hospital.
** Pathological examination by Dr. A. R. Camero.

intact mucosa. A layer of muscularis mucosae was seen between the fibrous capsule of the tumor and the mucosa indicating the origin of the tumor to be the submucosal layer of the bowel.

Case II. J. A., a white male, aged forty-eight, was referred for roentgen examination because of a six year history of the passage of bright red blood in the stools. For some months after the first episode of bleeding there were no other symptoms. Later, however, the patient complained of intermittent discomfort in the right lower quadrant. This discomfort was atypical

Fig. 2. Photograph of opened resected specimen, showing tumor mass.

Fig. 3. Barium enema examination with distal ileum filled, showing a conical shaped filling defect.

in nature and not necessarily associated with the presence of blood in the stool. Four years after the first onset of symptoms the appendix was removed without relief of the intermittent discomfort in the right lower quadrant and without any change in the frequency of bleeding.

A roentgen examination made one year later was reported as showing a deformity of the first portion of the duodenum which was thought to be due to duodenal ulcer. Although the clinical symptoms were not typical, an ulcer regimen was instituted without significant change in the clinical picture.

At the time of the present examination there were no symptoms except for a feeling of generalized weakness and intermittent discomfort in the right lower quadrant. The physical examination was entirely negative. Laboratory studies showed a moderate anemia with persistent occult blood in the stool.

Examination of the colon by barium enema showed no evidence of any deformity or filling defect. Accordingly barium was allowed to flow back into the ileum. At an estimated 48 cm. proximal to the ileocecal valve a radiolucent filling defect was noted (Fig. 3 and 4). The roentgen appearance suggested that the filling defect was due to an intraluminal mass. However, the appearance was unusual in that there

Fig. 4. Barium enema examination after evacuation, showing a polypoid intraluminal filling defect.

was in addition a cone-shaped deformity extending for several centimeters distal to the tumor defect itself. This was interpreted as representing a secondary intussusception. An attempt was made to demonstrate the tumor by means of a mouth meal. No abnormalities were noted until the barium reached the terminal ileum. At this time a large filling defect (Fig. 5) was noted, the appearance of which was typical of that of an intussusception. The tumor mass itself could not be outlined. There was no definite dilatation of the proximal bowel and no delay in passage of barium into the cecum.

After several preliminary blood transfusions operation was performed.* Exploration of the abdomen showed no evidence of duodenal ulcer. The appendix was absent and only a few fibrous bands were present at the site of resection. A tumor of the small intestine was found 60 cm. proximal to the ileocecal valve. The ileum both above and below the tumor was slightly dilated and the wall was thickened. The tumor was firm, smooth, and freely movable. Running proximally from the tumor there was a fibrous band which could be palpated through the lumen of the intestine. This band extended for about 10 cm. and terminated in an area of intussusception. The intussusception was manually reduced disclosing a large Meckel's diverticulum with a definite blood supply and a small separate mesentery. The diverticulum was removed without the necessity of resection and anastomosis.

The specimen (Fig. 6 and 7) had the appearance of a cylindrical mass lying within the bowel and extending proximally from a Meckel's diverticulum which was invaginated into the bowel lumen as the result of traction.* The tumor mass could be pushed outward into the diverticulum which projected 2 to 3 cm. above the surface of the bowel in the antimesenteric direction. The base of the specimen consisted of bowel wall of full thickness which was normal in appearance except for slight congestion. The remainder of the specimen consisted of a submucosal lipoma, 4 cm. in length and 1.5 cm. in diameter, over which the mucous membrane was pink and somewhat granular except for the distal third which was almost completely ulcerated, the edges being thin, indurated, and bright red in color. The stalk of the mass seemed to consist principally of

Fig. 5. Spot pressure film made three hours after oral administration of barium, showing an intussusception at ileocecal valve.

* Dr. Louis C. Bennett, St. Vincent's Hospital.

* Pathological examination by Dr. James Kahler.

lipoma submucosal structures including large vessels and muscle. Microscopically the tumor was composed of adult fat cells and represented the usual type of lipoma. In some areas the tumor was submucosal in position while in others it lay within the muscular coat and extended into the serosa. In the ulcerated area all of the epithelium had been lost and the mucous membrane and submucosa were replaced by granulation tissue highly vascularized and containing an exudate of polymorphonuclears, lymphocytes and plasma cells. No ectopic gastric mucosa was noted.

Fig. 6. Gross specimen, unopened.

In all patients who pass bright red blood in the stool, the possibility of a lesion of the distal small intestine must be considered, particularly if the proctoscopic, sigmoidoscopic and roentgen examinations of the colon (including air contrast study) are negative. The roentgen examination of the small bowel may be carried out by roentgenoscopic and roentgenographic examination during the progress of orally administered barium, or after its introduction through a short or long intestinal tube (the

Fig. 7. Gross specimen, opened.

so-called small intestinal enema). It is also of value to attempt a retrograde filling of the distal portion by means of a barium enema, as in the reported cases.

Benign tumors of the small intestine, most of which grow into the lumen, usually present themselves as intraluminal radiolucent filling defects, similar to those produced by polypoid lesions of the stomach and colon. Due to the difficulty of visualizing every segment of the small intestine they are difficult to demonstrate when very small. Since they are benign their life history is commonly prolonged, with months or years between the first onset of symptoms, often bleeding, and the development of obstruction. There is ample opportunity, therefore, for repeated examinations. Persistence in re-examination should lead to the demonstration of an increasing number of these tumors before the time when obstruction occurs.

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RECURRENT SMALL INTESTINAL INTUSSUSCEPTION IN CHILDREN

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WE wish to report 4 cases of intussusception of a type occasionally observed by pathologists and rarely by surgeons, but never heretofore, to our knowledge, demonstrated on roentgenograms. Dr Ross Golden,[5] to whom we submitted some of the films, has no recollection of similar cases from his own experience or the literature. The intussusceptions all were enteric (small intestinal), in 3 instances multiple and in 2, which we were privileged to reexamine, chronic or recurrent. The affected segments, usually jejunal, were short, approximating 3 centimeters in projected length, and the invaginations might present in different coils during the course of single or repeated studies, or might persist for a considerable interval in the same loop. No masses could be palpated, nor was there any close correlation between symptoms and the development or disappearance of intussusception during the course of the examination.

The 4 children, all girls between the ages of four and eight, offered somewhat similar histories of abdominal pain occurring in attacks without constant relation to eating or defecation. The pain, of variable severity, might or might not be accompanied by nausea and vomiting. The attacks were, in some instances, transient and relieved by momentary cessation of activity or by emesis, but sometimes sufficiently severe to call for immediate medical attention. A lessened interval between attacks, however severe, was another reason for seeking advice. Nevertheless, all 4 of the patients were well nourished, active children who, apart from the bouts of cramping abdominal pain, presented no symptoms or signs of disease. Weight loss was insignificant and could be attributed to a disinclination for food. Bleeding from the bowel, frank or occult, was never observed. There were no relevant factors in the personal or family history and the physical examination was essentially negative. Examination of the urine, stools (particularly for parasites) and blood offered no clues, slight anemia and eosinophilia in 1 case excepted.

A tabular comparison with data derived from the series of Ladd and Gross[8] points up fundamental differences between intussusception as commonly regarded and as considered here (Table 1).

Multiple small intestinal intussusceptions are seen not infrequently by pathologists in the course of routine necropsies.

TABLE I

	Ladd and Gross Series (484 cases)		Authors' cases
Etiology	95%—no demonstrable etiological agent		No obvious etiological agent—allergy of undetermined significance.
Age	Peak 3–11 months (75%)		4–8 years
Sex	Male 62%; female 38%		All female
Site	Jejuno-ileal or ileocecal	5%	All jejunal and ileal
	Ileocolic	75%	
	Ileo-ileocolic	12%	
	Colocolic	12%	
	Not stated	5%	
Number	Multiple	1%	Multiple, 3 of 4
Chronic or recurrent	2%		At least 2 of 4

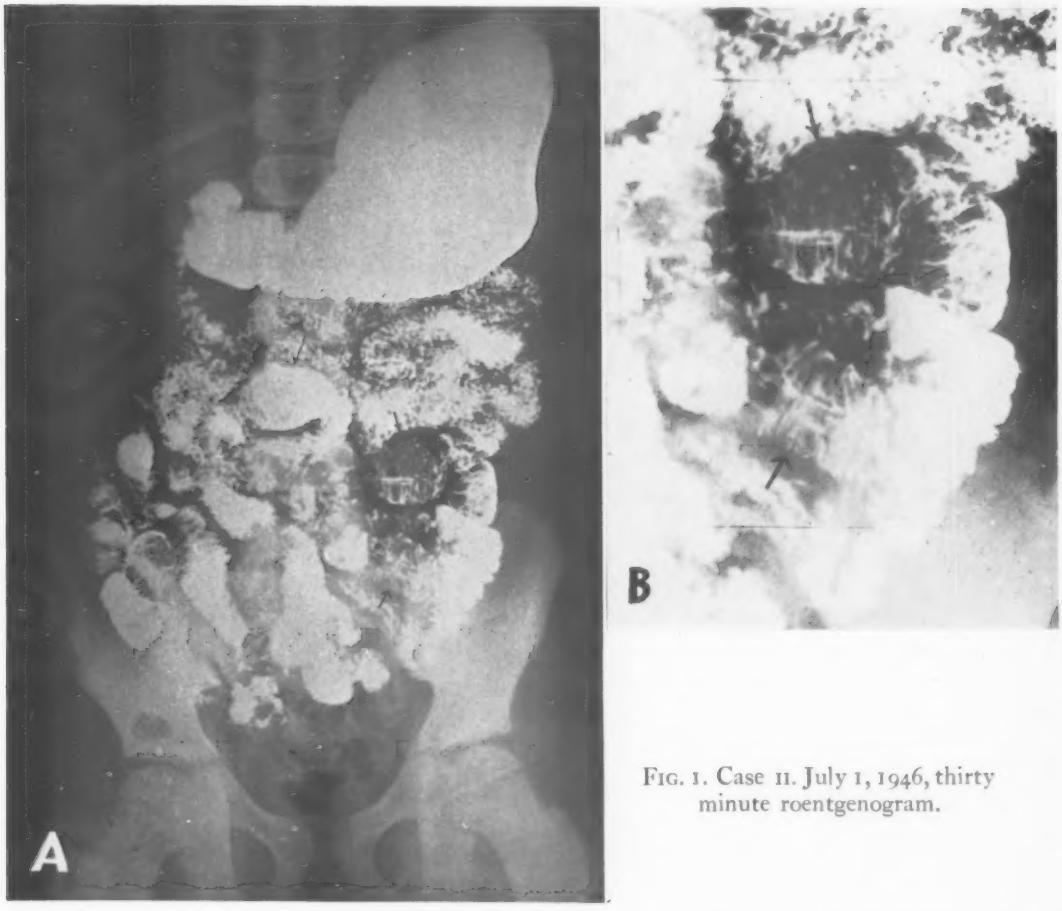

FIG. 1. Case 11. July 1, 1946, thirty minute roentgenogram.

They are more numerous in infants than in older children, more common in the jejunum than the ileum and usually are retrograde (Baron[1]). Presumably these are agonal phenomena, the telescoping being easily reducible, with no evidence of vascular change or peritoneal reaction. They must be attributed to extreme neuromuscular dysfunction and incoordination in the last moments of life.

A cursory survey of the literature finds several references to recurrent (or chronic) and multiple intussusceptions. The diagnosis usually was made at the operating table, but sometimes was inferential. In practically all of these cases symptoms were sufficiently severe and characteristic to suggest the presence of a surgical emergency, and in many a preoperative diagnosis of intussusception was made. Baron[1] operated on a male child two years of age, eleven hours after the onset of severe intermittent abdominal pain, and found five distinct intussusceptions in a 25 cm. segment of jejunum. All were in the usual direction, i. e. aboralward and all were easily reduced. There were no gross changes in the bowel wall. Gill[4] reports similar findings in a female of nineteen months who developed intermittent acute abdominal pain after administration of a vegetable purgative. Six or seven separate ileo-ileal intussusceptions were visible. All were reduced without difficulty and only the first showed congestion of the bowel wall. Active peristalsis with attempts to reproduce the intussusception was noted at laparotomy, but there was no recurrence. Feldman[3] quotes references to multiple intussusceptions of the small intestine, but emphasizes its rarity. H. G. Close[2] in a survey of 363 cases of acute intussusception in children

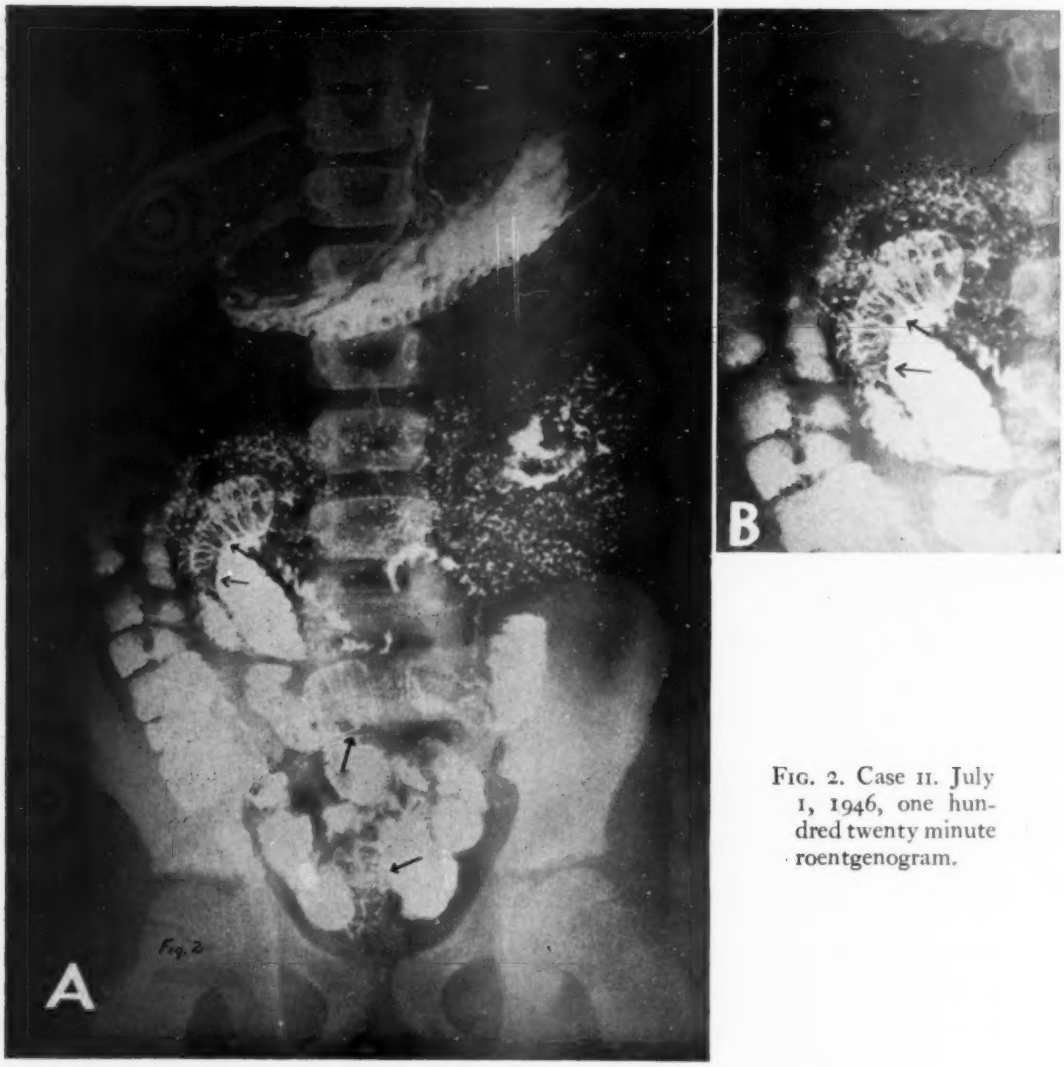

FIG. 2. Case 11. July 1, 1946, one hundred twenty minute roentgenogram.

found 3 instances of multiple foci and Baron,[1] reviewing the literature since 1870, tabulates 19 cases.

Spontaneous reduction of acute intussusception in children is described by Goldman and Elman.[6] Their material is limited to ileal and ileocecal types, but the conclusions which they draw probably are relevant. They believe that spontaneous reduction of acute intussusception is more frequent than is commonly believed and that chronic forms usually are intermittent recurrences. Not all the cases present a classical syndrome, the symptoms in some instances being vague and indefinite. In Ladd and Gross's[8] series of recurrences, the longest interval between the initial and succeeding episode was seven years. Feldman quotes Thorndike[10] and Ruff[9] with regard to the infrequency of recurrence (1.2 per cent and 2 per cent respectively). However, it has occurred to keen pediatricians (Holt and Howland[7]) that spontaneous reduction of recurrent intussusceptions might not be so very unusual and was a likely explanation for some cases of severe colic. It is our belief that the 4 cases here presented and an additional patient, whose findings at laparotomy we will describe, support this clinical hypothesis.

One must, in view of Nothnagel's[7] ex-

periment, interpret intussusception as an effect of neuromuscular dysfunction. For some reason, the orderly alternation of contraction and relaxation is interrupted and a contracted segment is invaginated by the distal (almost invariably) intestine. Once begun, the intussusception increases only at the expense of the external layer. The telescoping does not necessarily produce either obstruction or strangulation, but usually both are present and are the prime causes of symptoms. Traction upon the mesentery leads to interference with the blood supply, causing congestion, edema, hemorrhage and ultimately gangrene. If, however, the intussusception affects short segments and particularly when it is transient, none of these changes needs occur.

We should like to describe first a case without positive roentgen findings because the history is like that of the other patients and because the observations of the surgeon were so striking and apropos. It is assumed that preoperative roentgen studies were negative because a complete small intestinal investigation was not made and those roentgenograms which were secured were not at optimum intervals.

CASE REPORTS

Case I. H. B., male, aged five. This child, for three years before admission to the hospital, had intermittent attacks of abdominal pain with nausea and, rarely, vomiting. The pain, which was of a dull aching character, was greatest in the peri-umbilical region and in the left upper quadrant. In the past month these symptoms had been most pronounced immediately after meals. There was no relief by defecation, and no history of constipation, diarrhea or bloody stools was elicited. Weight loss was insignificant.

Past and Family History. Non-contributory.

Physical Examination. Negative, except for slight tenderness to deep palpation to the left of the umbilicus.

Roentgen Findings. Essentially negative.

Laboratory Findings. Gastric analysis, urine, stools, blood counts were all normal.

Preoperative Impression. Possible Meckel's diverticulum.

Fig. 3. Case II. July 3, 1946, sixty minute roentgenogram.

Operation (Dr. J. D. Rives). The jejunum exhibited hyperperistalsis and three or four short segmental intussusceptions were visible when the abdomen was opened. These were reduced without difficulty, but others developed. No changes were visible in the bowel wall, and careful palpation revealed no evidence of small intestinal tumor. Mesenteric lymphadenitis of minor degree was present and one node was removed for biopsy. The ileum was normal, and no Meckel's diverticulum could be found.

Further Course. The internist considered the possibility of intestinal allergy as an etiological factor. Elimination of milk from the diet immediately relieved the symptoms, which have not recurred in the seventeen month interval to the present.

Case II. C. H., female, aged eight. This patient was examined first on July 1 and 3, 1946, and again on November 10, 1947. For several months prior to the first examination the child complained of peri-umbilical pain occurring

three to four times daily. The pain increased in frequency later to four or five attacks daily. It was not associated with eating and not relieved by food. When an attack occurred the child would stop playing momentarily and then would resume her activities with no after effect. Her appetite was poor. There was no flatulence or belching; the bowels were regular and no history of bleeding from the rectum could be elicited. There was very slight weight loss.

Past and Family History. Non-contributory.

Physical Examination. Well developed and nourished girl, not acutely ill. No tenderness at first examination, but moderate tenderness below the umbilicus was found at the second study. No masses could be felt.

Laboratory Findings. Gastric analysis, urine, stools and blood count were normal except for persistent eosinophilia (5 per cent) and slight anemia.

Roentgen Findings. First examination July 1, 1946.

1. Thirty minute film (Fig. 1): Three short, well defined proximal jejunal intussusceptions are seen. The head of the column is in the ileocecal region. The lower small intestinal coils are segmented.

FIG. 4. Case 11. November 10, 1947, sixty minute roentgenogram.

2. One hundred twenty minute film (Fig. 2): At least two, and probably three, intussuscepted segments, apparently not the same coils as were affected at the thirty minute interval, are seen.

3. Two hundred forty minute film: Small intestine practically empty.

Second examination July 3, 1946.

1. Sixty, 120 and 180 minute films (Fig. 3): Evidence of neuromuscular dysfunction, but with no recognizable intussusception.

Third examination November 10, 1947.

1. Sixty minute film (Fig. 4): Hypermotility,

Fig. 5. Case III. November 17, 1947, thirty minute roentgenogram.

Fig. 6. Case III. November 17, 1947, sixty minute roentgenogram.

segmentation of the distal small intestine and at least three telescoped segments are observed. These are at approximately the same levels as the initial study.

Further Course. The symptoms were relieved by administration of antispasmodic (phenobarbital, atropin) and antihistaminic (elixir benadryl) drugs. The eosinophilia suggests that the symptoms might have an allergic background and that the administration of benadryl was the significant therapeutic measure.

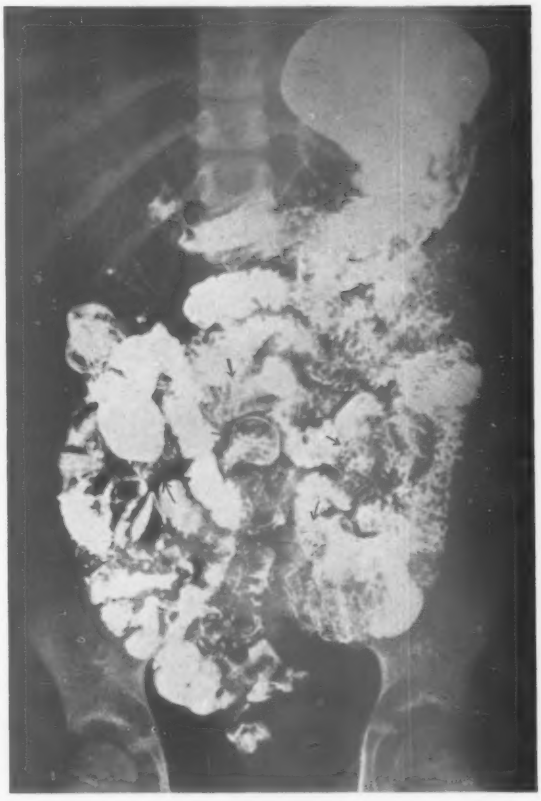

Fig. 7. Case III. January 30, 1948, sixty minute roentgenogram.

Case III. S. L., female, aged four. Colon examined first on November 17, 1947, and again January 30, 1948. This child complained of cramping abdominal pain for two months. The pain was quite severe and came on in attacks which might last an hour and occur two to three times daily. There was no nausea or vomiting,

FIG. 8. Case III. January 30, 1948, ninety minute roentgenogram.

and the pain was not related to nor affected by eating. Normal weight gain was maintained. The bowels were regular, and she never passed blood by rectum.

Past and Family History. Not significant.

Physical Examination. Negative.

Laboratory Findings. Urine, stools and blood count normal.

Roentgen Findings. First examination November 17, 1947.

1. Thirty minute film (Fig. 5): Two short segmental intussusceptions, one in the distal jejunum, the second probably in the ileum, are demonstrated.

2. Sixty minute film (Fig. 6): The head of the opaque column is in the ascending colon. One, possibly two, intussuscepted coils are visible in the pelvic ileum.

3. Three hundred sixty minute film: Small intestine empty.

Second examination January 30, 1948.

1. Thirty minute film: Distortion of small intestinal pattern.

2. Sixty minute film (Fig. 7): Four to six intussusceptions, probably all in the jejunum, are present. One in the proximal jejunum is not visible on the thirty minute film.

3. Ninety minute film (Fig. 8): Spontaneous reduction of the intussusception, but with residual telescoping of coils in the mid-abdomen.

4. One hundred twenty minute film: Two persistent intussusceptions, one in the proximal jejunum and one in the distal jejunum or proximal ileum, are seen.

5. One hundred fifty minute film (Fig. 9): At least two persistent invaginations are present. These are not so well defined as before, presumably because the bulk of the opaque material has passed beyond them.

6. One hundred eighty, 210 and 240 minute films: Segmentation and hypertonicity, but no evidence of intussusception.

7. Three hundred sixty minute film: Small intestine empty.

Further Course. The attacks of cramping pain continued for four months after the initial visit (six months in all). They were not relieved by antispasmodic drugs and no antihistaminic medication was administered. Substitution

FIG. 9. Case III. January 30, 1948, one hundred fifty minute roentgenogram.

diets to investigate a possible allergic basis were ineffectual. The symptoms subsided spontaneously and have not recurred.

Case iv. K. C., female, aged five. This child complained of severe abdominal pain, first experienced one month before she was examined. The initial attack occurred at night and was prolonged for two hours, the pain being associated with a "cold sweat" and vomiting. There was a similar episode the next morning, with repetition of the nocturnal attacks at intervals for two weeks. In the interim the child was asymptomatic. After two weeks the free intervals were less and the patient had abdominal pain several times daily, during the day as well as at night. The symptoms were more severe when she was hungry. Her appetite was poor, but she lost little weight. Bowel movements were regular, with no history of bleeding.

Past and Family History. Recurrent swelling of lips and "hives?" one month before. Otherwise negative.

Physical Examination. Negative.

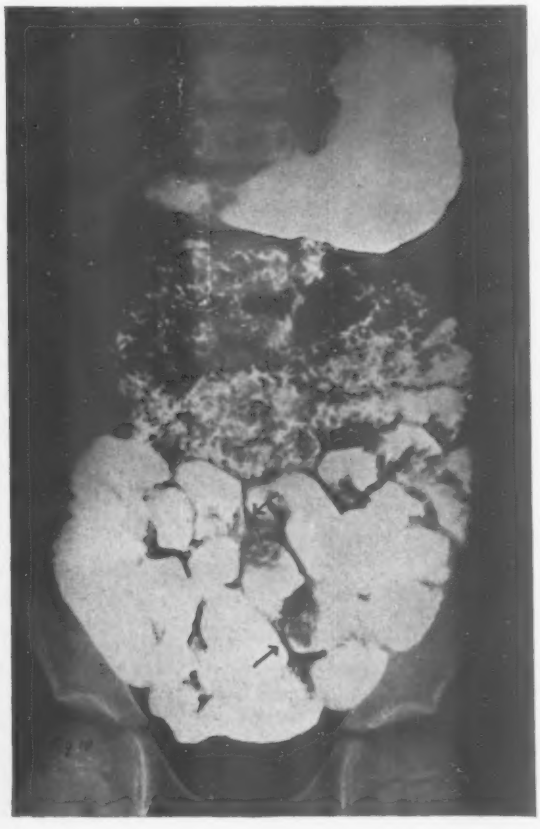

Fig. 10. Case iv. May 13, 1948, forty-five minute roentgenogram.

Fig. 11. Case v. January 25, 1948, one hundred twenty minute roentgenogram.

Laboratory Findings. Urine, stools and blood count normal.

Roentgen Findings. A single forty-five minute interval film taken on May 13, 1948 (Fig. 10) shows two short intussuscepted segments in the mid and lower jejunum.

Further Course. Although the child still complains occasionally, the symptoms have been much less severe since she has been taking elixir of pyribenzamine.

Case v. M. K., female, aged three. For approximately one year this child had intermittent episodes of abdominal pain, usually in the morning, although occasionally she was awakened by the pain. The attacks, which at first lasted approximately one hour and later about fifteen minutes, came on with meals, but also when she was playing hard or was excited. There might be one or several daily. Nausea and vomiting occurred commonly, but not invariably. The bowel movements were frequent, with passage of undigested food particles, but no blood. Weight gain had been steady until the

onset of symptoms, after which time the patient lost 3 pounds.

Past and Family History. Non-contributory.

Physical Examination. Negative.

Laboratory Findings. Urine, stools and blood count normal.

Roentgen Findings. January 25, 1948. At 120 minutes (Fig. 11) the head of the column has reached the terminal ileum. The small intestinal pattern is disorderly and one short enteric intussusception is present in the lower jejunum or proximal ileum.

Further Course. This patient developed urticaria when offered atropin and benadryl. She was given a bland diet and is much better, although one or two recurrent episodes within the past two months have been experienced.

SUMMARY

Five cases of small intestinal intussusception are described and roentgenograms of four are reproduced.

CONCLUSIONS

1. Small intestinal intussusception in young children is more frequent than is commonly believed.

2. It is presumably a manifestation of neuromuscular dysfunction and, in some instances, may be an allergic response.

3. The intussusception, which is transient, recurrent and usually involves multiple segments of the small intestine, produces rather constantly, intermittent abdominal pain with nausea and sometimes vomiting.

4. The symptoms may be present for months or years and the single attacks may be very severe. However, there is no strangulation or obstruction. No tumor masses can be felt, and there is no bleeding from the bowel.

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Vol. 63, No. 1

THE NATURE OF FICTITIOUS POLYPS IN THE COLON*

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WHEN the double contrast examination of the colon has been properly completed, the roentgenologist is able to detect very small neoplastic lesions. At times confusing shadows are present which are not true polyps but which we term fictitious polyps.[1] Since the introduction of the double contrast examination in 1925 by Fischer[2] of Germany no satisfactory explanation has been offered for the exact nature of these polyp-like shadows.

To one familiar with the double contrast procedure, the interpretation of the roentgenograms is usually not made more difficult by the presence of these polyp-like areas but at times they can be confusing. We have always thought that if we could determine the nature of these shadows we would have a better understanding of their differentiation from true polyps.

Recently we obtained a satisfactory set of double contrast roentgenograms of the colon but because one area was not well visualized we repeated the examination about twenty minutes later. The first examination showed no fictitious polyps while

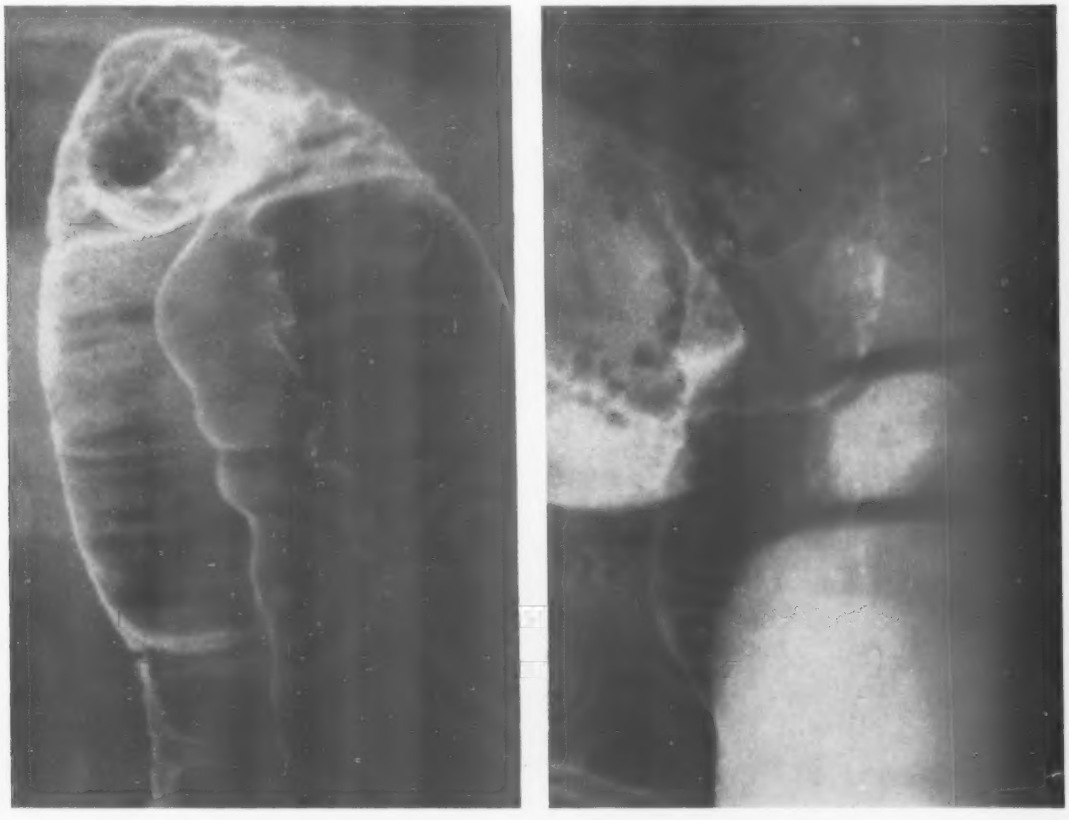

FIG 1. Splenic flexure. No fictitious polyps on first examination (left). Numerous fictitious polyps in splenic flexure noted on second examination twenty minutes later (right).

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† Fellow in Radiology, Scott & White Clinic.

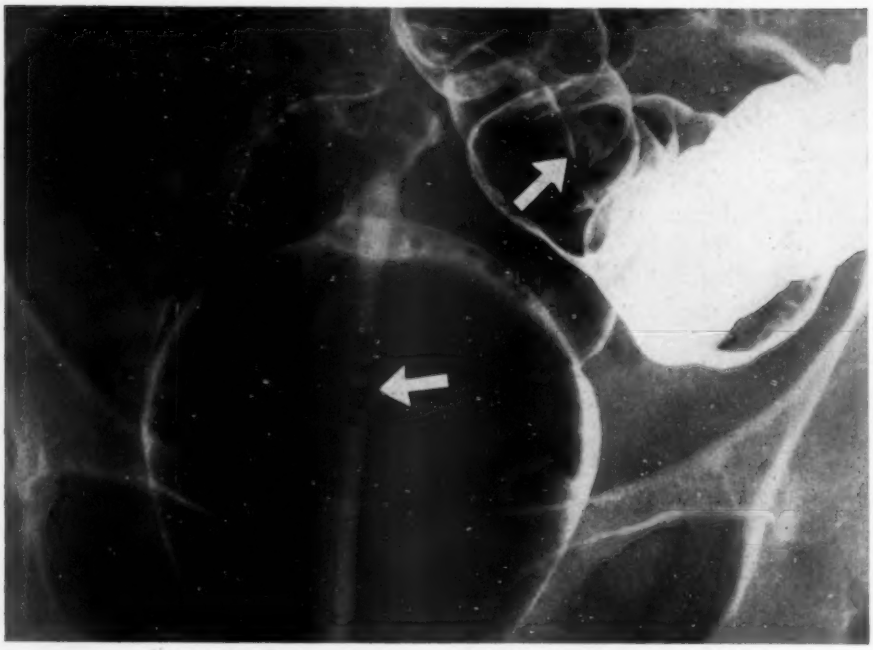

FIG. 2. Bardex-Virden catheter. Balloon distended with air. Note fictitious polyps in sigmoid area and similar shadows in the catheter.

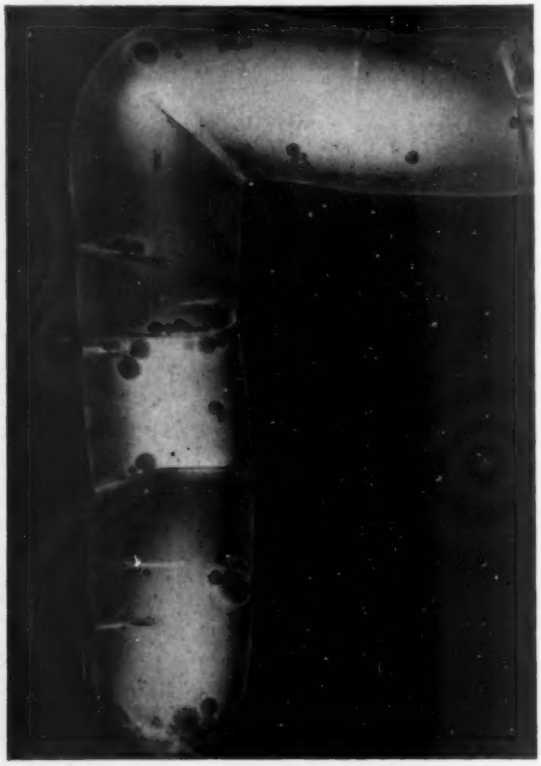

FIG. 3. Right half of simulated rubber colon. Double contrast examination shows typical fictitious polyps due to air bubbles.

to our surprise there were numerous polyp-like shadows on the second set of roentgenograms (Fig. 1).

We thought that these shadows were artificially produced and not due to some component of fecal material. A few weeks after this we noted fictitious polyps in the sigmoid area of a patient on whom we used the Bardex-Virden catheter. Within the inner lumen of the catheter we noted similar shadows and surmised that they were air bubbles (Fig. 2).

In order to investigate the possibility that air bubbles might cause these false polyps, we formed an artificial colon out of a large Penrose surgical drainage tube. The double contrast examination was done in a manner similar to that which we employ in the human. The introduction of air through the partially barium filled rubber colon easily formed bubbles which roentgenographically were identical to those we had observed in the 2 previously mentioned patients (Fig. 3). Fecal material was then placed in the simulated colon and barium and air double contrast studies showed that it was possible to differentiate easily be-

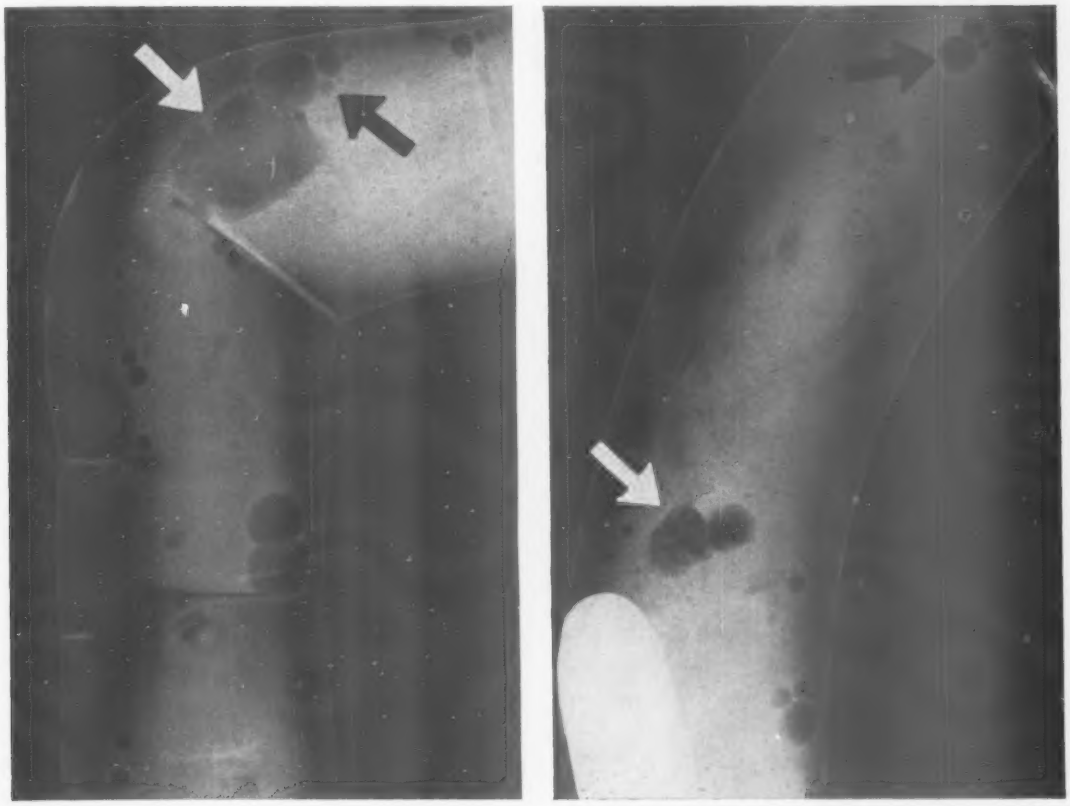

Fig. 4. Two segments of artificial colon. White arrows point to fecal material; black arrows to air bubbles. Note how easily they may be differentiated.

tween fecal particles and air bubbles (Fig. 4). Starting again with a clean rubber tube we were able to form fictitious polyps with castor oil, mineral oil and vegetable oil (Fig. 5). Animal fat which is liquid at body temperature and vaseline at body temperature also formed fictitious polyps.

Air bubble formation is closely related to surface tension and we found that by blowing through a glass pipette into a barium suspension it was rather difficult to form bubbles. However when bubbles did form they were easily broken by agitation of the suspension either by vigorous bubbling of air or by a slight blow on the side

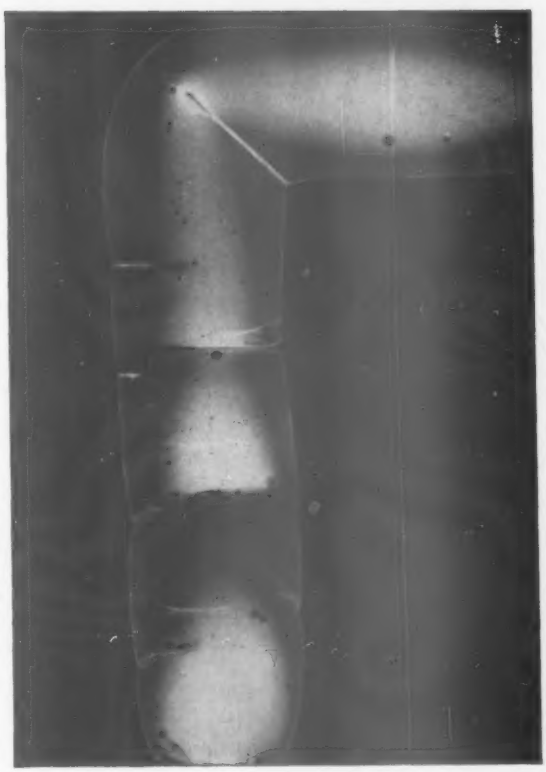

Fig. 5. Right half of rubber colon. Fictitious polyps formed by castor oil. Other oils and liquid fats caused similar shadows.

of the container. In an effort to apply this discovery to the human, we have observed that rapid introduction of air into the colon tends to definitely less fictitious polyp formation than does slow administration of air (Fig. 6).

Comparison of the experimentally produced fictitious polyps, both in the rubber tube and in a patient, enables the roentgenologist to have a better understanding of the problems arising in distinguishing these false shadows from true polyps (Fig. 7).

All fictitious polyps which we have produced have a radiolucent center and a very thin ring of increased density, due to barium, about this clear center. Individual air bubbles as well as oil globules are circular in outline and cannot be differentiated on the roentgenogram, but quite often two or more air bubbles will be in contact and appear faceted. This does not happen with the oils.

Fictitious polyps formed by fecal material are not spherical and can be of any irregular size or shape. The periphery of the shadow is irregular and ragged while the center is slightly radiopaque.

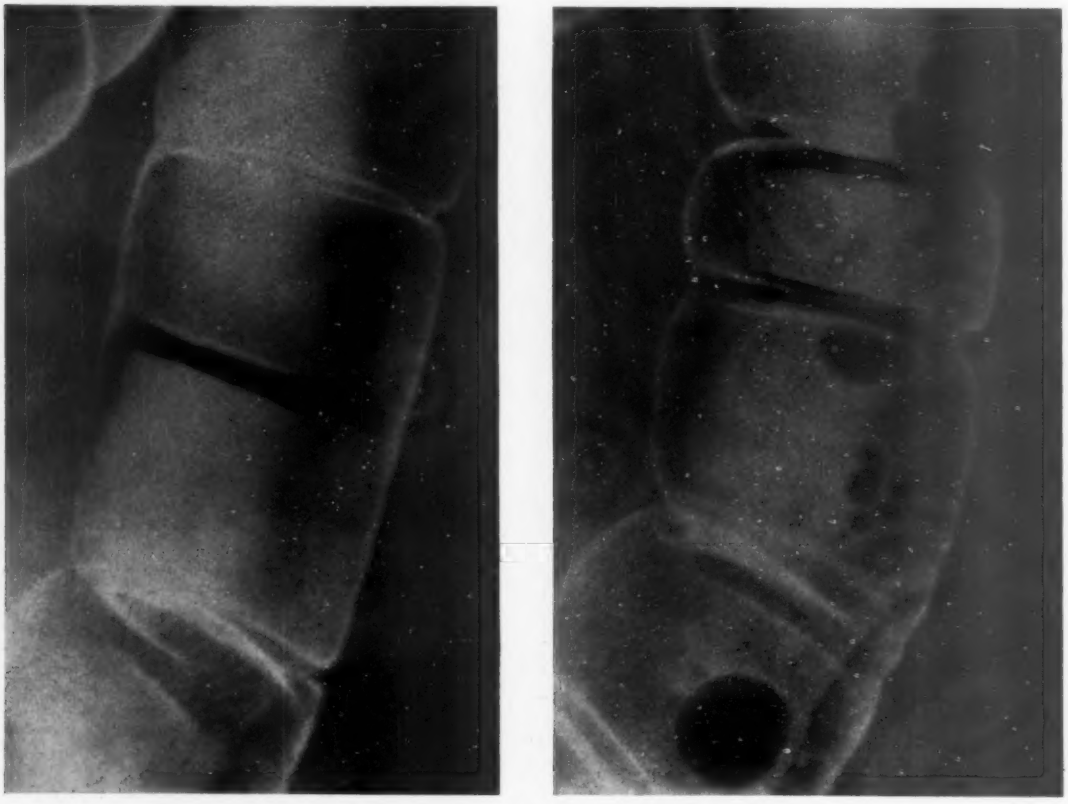

FIG. 6. Segment of descending colon in an adult. Double contrast roentgenogram on the left shows no false polyps. The air was introduced rapidly. The film on the right was made ten minutes later on the same patient and shows numerous false polyps. The air was introduced slowly.

True polyps are usually not definitely spherical and their neoplastic substance is more radiopaque than the center of fictitious polyps (Fig. 8). Quite often the flat attachment of a sessile polyp or the pedicle of a pedunculated polyp can be visualized so that differential diagnosis is not diffcult.

The fat splitting enzymes in the small intestine are capable of hydrolyzing about 30 cc. of castor oil.[3] The laxative effect is due to one of the products of hydrolysis, namely ricinoleic acid. If castor oil is given

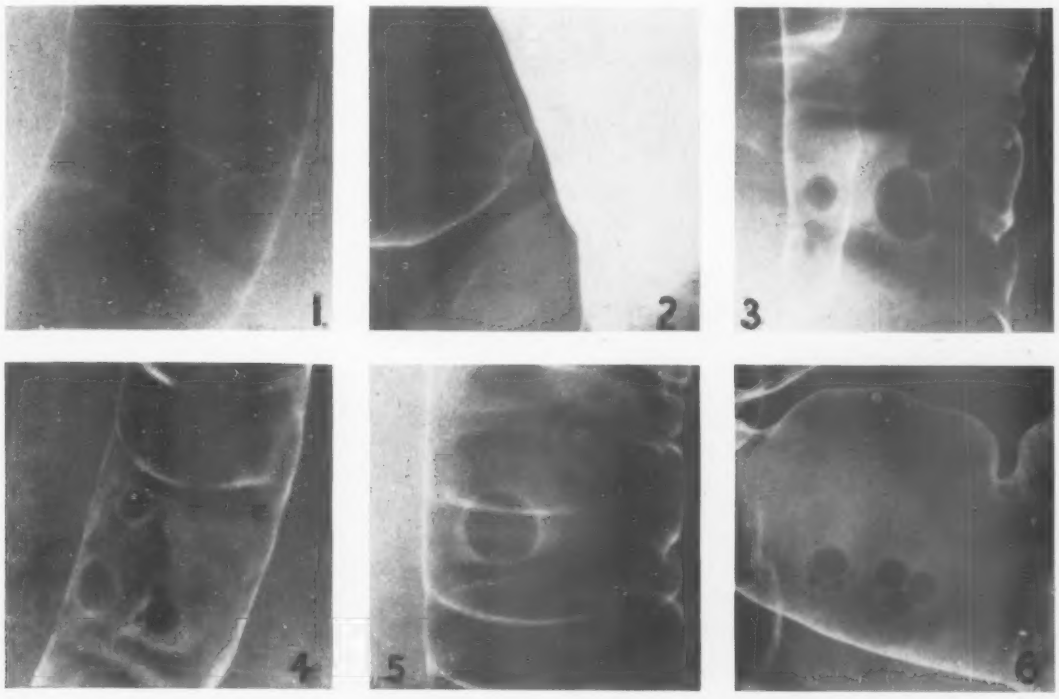

Fig. 7. Segments of the colon of 6 different patients to show various types of fictitious polyps commonly encountered, Note faceted shadows in upper right illustration.

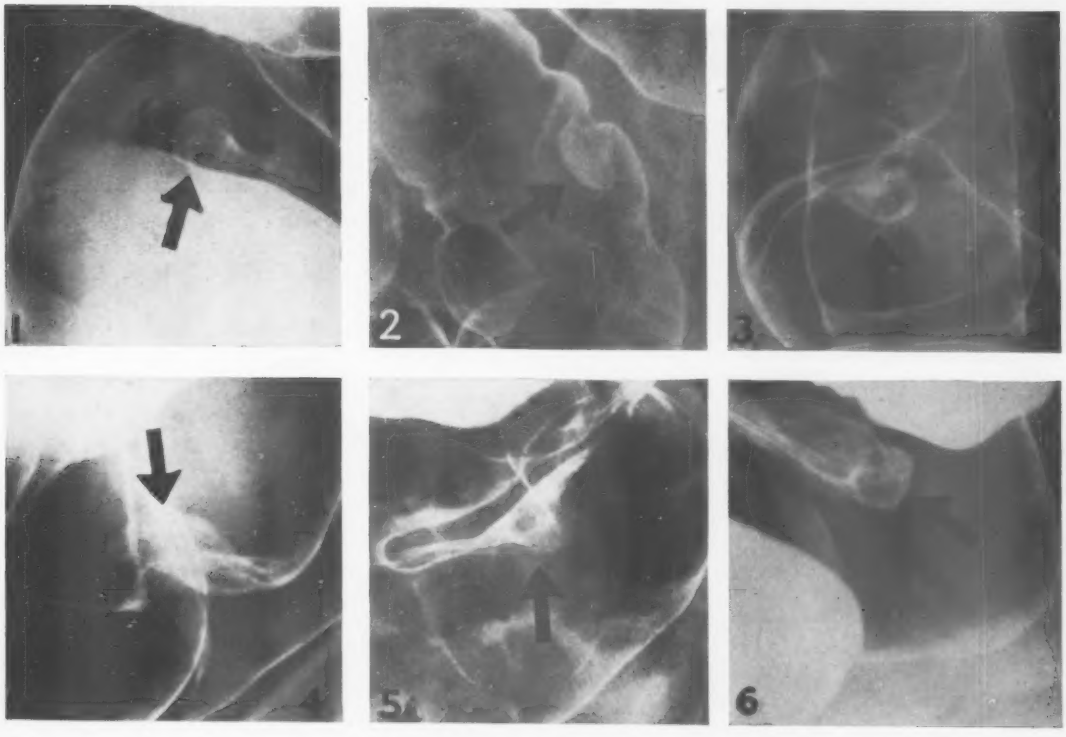

Fig. 8. Segments of the colon of 6 different patients to show true polyps. Compare in detail with Figure 7.

in doses of more than one ounce, the excess which is not hydrolyzed will pass through the small intestine unchanged. In support of these pharmacologic findings we found that one large group of patients averaged just as many bowel movements with one ounce of castor oil as did a similar group with two ounces.

Since we have formed typical fictitious polyps with castor oil in the simulated colon, it is possible that excess castor oil can form these shadows in the human colon. Their occurrence can be minimized or avoided by limiting the dose of castor oil to one ounce.

Mineral oil, vegetable oil and excess fats may be eliminated from the diet a day or two before the double contrast examination; however, it is not practical or necessary to eliminate all fats from the diet for apparently they are not commonly a cause of false polyp shadows.

Repeated use of vaseline lubricated enema tips prior to the double contrast examination may cause the patient to introduce this material into the rectum where the body temperature changes the vaseline to a liquid. As we have shown with the artificial colon, liquid vaseline can be a cause of fictitious polyp formation.

We have demonstrated the nature of fictitious polyps as seen on double contrast roentgenograms of the colon and have determined how to minimize their formation. However, in the conduct of the double contrast examination stereoscopic roentgenograms should be made with the patient in the supine position and repeated with the patient in the prone position. False polyps will invariably change in size, shape, or position or may even disappear as a result of this procedure.

CONCLUSION

1. Fictitious polyps as noted on double contrast roentgenograms of the colon are largely due to air bubbles formed by the introduction of air through fluid barium during the double contrast examination.

2. Unhydrolyzed castor oil, mineral oil, vegetable oil and fats and greases which are liquid at body temperature may cause fictitious polyp formation.

3. We have reproduced these false polyps in the human and also in a simulated rubber colon.

4. Criteria for the differentiation of fictitious polyps from true polyps are discussed.

5. Methods to minimize fictitious polyp formation are suggested.

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CARCINOMA OF THE TESTICLE WITH METASTASIS TO BONE*

REPORT OF TWO CASES, ONE IN A PSEUDOHERMAPHRODITE

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CANCER of the testis infrequently metastasizes to bone.[1] In several reports[8,10,11] in which 313 cases are summarized bone metastases are not mentioned as being present, although many of these patients did not come to autopsy. Only 4 of a series of 37 cases coming to autopsy, reported by Barringer and Earl,[2] showed metastasis to bone. In these the ribs were involved three times, the spine twice, and the calvarium once. In the series of 60 cases seen in our clinic,[5,12] bone lesions were present in only 2 cases, and these form the basis of this report.

One of these 2 cases had abdominal testes and congenital defects which would cause him to be classed as a pseudohermaphrodite, and this furnishes additional interest. It is now well recognized that cancer more commonly occurs in ectopic testes than in those normally placed[4,6,7,11] and cases of pseudohermaphroditism are no longer considered rare. Gilbert and Hamilton[7] have shown, in a series of 345 tumors of abdominal testes, that 11 per cent had associated congenital defects which put them in the class of pseudohermaphrodites, with these defects ranging from hypospadias to rudimentary portions of the female reproductive tract.

In 1 of the 2 patients being reported, pain from bone metastasis was the predominating symptom of carcinoma of an undescended testicle, and in the second case the bone lesions appeared as the patient's condition became terminal.

CASE REPORTS

CASE 1. N. F., a white male, aged thirty-four, who gave the following history: At birth it was noticed that there were bilateral undescended testicles and complete hypospadias. Attempts had been made from the time he was three years old to correct the latter, but these met with only partial success. When the patient was nineteen, a mass was found on rectal examination and exploration of the abdomen revealed bilateral abdominal testicles. No prostatic tissue could be found, but a mass was found posterior to the bladder, communicating with the posterior urethra, which on pathologic examination was found to be an infected uterus. One of the testicles was removed and this showed no evidence of spermatogenesis. No structures of ovarian origin could be found. Following this operation, further attempts were made to establish an anterior urethra, which were unsuccessful. The patient was well adjusted as a male and later married.

He was referred to us in March, 1945, for roentgen examination of the pelvis and hips because of severe pain in the left hip of several months' duration. An area was noted in the left ilium which showed slight demineralization (Fig. 1) but its significance was not determined. The patient was treated symptomatically, but the pain continued.

In July, 1945, the patient was in Boston and consulted Dr. Channing Frothingham, and another roentgen examination of the pelvis, lumbar spine, and left femur was made. This revealed definite metastatic lesions in the area which had shown slight demineralization (Fig. 2*A*), definite lesions in the left femur, and in the bodies of several of the lumbar vertebra (Fig. 2*B*).

A biopsy of the lesion in the ilium was reported as showing: "Carcinoma (seminoma type) of the ilium following carcinoma of undescended testis," with the note "the morphology is characteristic of a testicular tumor, probably seminoma, although embryonal carcinoma is a possibility."

Following discovery of this metastatic focus,

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FIG. 1. Case 1. March 19, 1945. The left ilium shows an area of demineralization just above the acetabulum. At this time the rarefaction was not regarded as significant.

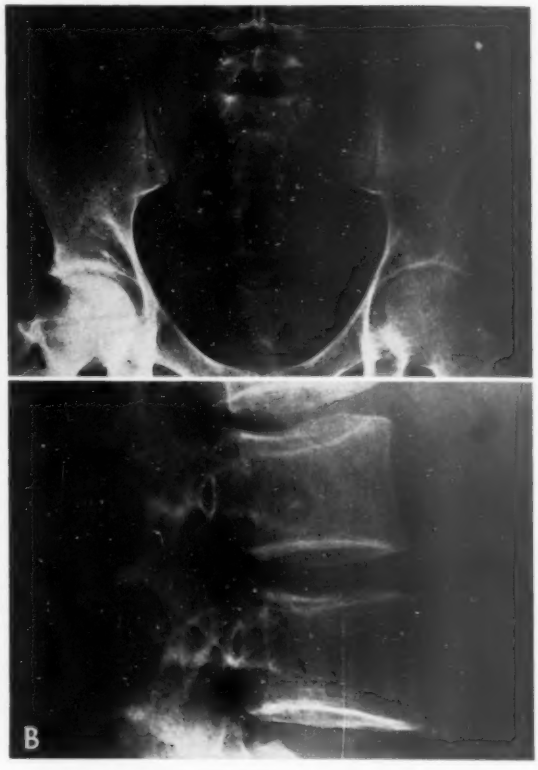
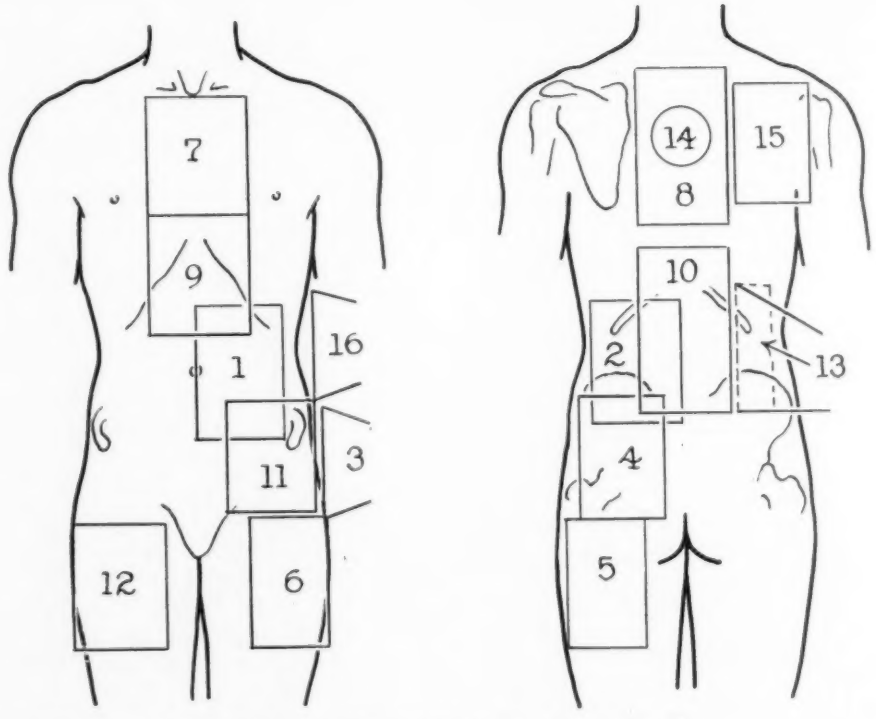


FIG. 2. Case 1. (*A*) September 17, 1945. The area of demineralization shows definite destruction and the diagnosis of metastatic disease was made. (*B*) Same date as (*A*). An area of bone destruction is seen in the body of the fourth lumbar vertebra.



Case 1 - Diagram of portals treated.

FIG. 3.

high voltage roentgen therapy was given to the lesion in the left ilium, femur, and lumbar spine (Chart 1) (Fig. 3). Treatment was also given to the mediastinum in an attempt to retard spreading. The patient became free of pain during this course of therapy.

It was subsequently felt that the spread of the tumor could be better controlled if the primary process was removed, so in November, 1945, exploration of the abdomen was carried out by Dr. Edward L. Young of Boston. At the brim of the pelvis on the left, a white fibrous mass, adherent to the surrounding tissue, was found and removed, but involvement of no other organs could be found. Sections showed fibrous tissue and embryonal carcinoma. The pathologist felt that this represented the original tumor which had been subjected to heavy irradiation, and that the tissue removed at the first biopsy was the same tumor showing a variation in the cellular structure which resembled seminoma. The growth extended to the edge of the operative specimen and no testicular tissue was found.

The patient was seen in our clinic at intervals during 1946 and was symptom free. Roentgenograms of the pelvis showed no change during this time (Fig. 4*A*).

Number in Diagram (Fig. 3)		Technique Number*	Field	Roentgens (measured in air)	Tissue Roentgens
	CHART I—(CASE 1)				
	Area Treated—1945				
1	Anterior oblique lumbar spine	1	15×20 cm.	2400	3120
2	Posterior oblique lumbar spine	2	15×20	2400	
3	Left lateral pelvis	2	15×20	1500	2100
4	Posterior left ilium	2	15×20	1500	
5	Anterior left femur	2	15×20	1500	2250
6	Posterior left femur	2	15×20	1500	
7	Anterior mediastinum	3	15×20	1050	1070
8	Posterior mediastinum	3	15×20	900	
9	Anterior abdomen	3	15×20	900	1200
10	Posterior abdomen	3	15×20	1000	
	CHART II—(CASE 1)				
	Area Treated—1947				
4	Posterior left ilium	2	15×20	1200	2005
11	Anterior left ilium	2	15×20	1400	
3	Lateral left ilium	2	15×20	200	
12	Anterior right femur	2	15×20	1000	750
6	Anterior left femur	2	15×20	200	150
9	Anterior abdomen	2	15×20	2000	1880
9	Anterior abdomen	4	15×20	1350	
13	Posterior oblique lumbar spine	2	15×20	1000	480
14	Dorsal spine	2	9 cm.	700	980
8a	Posterior dorsal spine	2	10×13	1100	
15	Posterior right shoulder	2	15×20	600	690
16	Left lateral chest	4	15×20	500	340

* *Techniques*
1. 200 kv.p., 20 ma., 50 cm. S.T.D., 0.4 mm. Sn+0.25 mm. Cu+1 mm. Al, H.V.L. 2 mm. Cu.
2. 200 kv. 15 ma., 50 cm. S.T.D., 0.4 mm. Sn+0.25 mm. Cu+1 mm. Al, H.V.L. 2 mm. Cu.
3. 200 kv. 15 ma., 50 cm. S.T.D., 0.5 mm. Cu+1.0 mm. Al, H.V.L. 1.1 mm. Cu.
4. 200 kv. 15 ma., 80 cm. S.T.D., 0.4 mm. Sn+0.25 mm. Cu+1 mm. Al, H.V.L. 2 mm. Cu.

In April, 1947, there was a recrudescence of the pain in the left hip and lumbar spine, with pain developing in the right femur and dorsal spine. Metastatic areas were again found in the lumbar spine (Fig. 4*B*), in the right femur, and in the dorsal spine (Fig. 5). The liver was enlarged and nodules were found in the chest. Irradiation was directed to these areas of bone pain, but relief could be obtained for only three to four weeks, even with doses approaching skin

tolerance. His course was steadily retrogressive, and the pain during the end-stage was not relieved by roentgen therapy (Chart II) (Fig. 3), or by large doses of morphine or demerol. The liver also continued to enlarge and further metastatic foci appeared. The patient died in October, 1947, approximately two years and eight months after the first appearance of symptoms.

FIG. 4. Case I. (*A*) February 14, 1947. The area of destruction in the pelvis shows some sclerosis, interpreted as evidence of healing following heavy irradiation. This area showed no further change until the patient's death. (*B*) September 8, 1947. Destructive changes can be seen in the bodies of the third and fourth lumbar vertebrae. The process in the fourth lumbar vertebra is essentially unchanged since it was first noted two years previously.

The essential findings at postmortem were: cachexia, bilateral nodular pulmonary metastases, enlarged mediastinal nodes, enlargement of the liver with almost complete replacement of the normal liver tissue by tumor tissue, marked enlargement of the retroperitoneal lymph nodes with invasion of the perirenal fat of the left kidney and displacement of the kidney, and infiltration of the marrow of the lumbar vertebra with tumor cells. No tumor cells could be found in the left ilium. The femora were not examined. The urogenital organs showed that the urethra opened on the ventral aspect of the base of the penis, and there were scars of unsuccessful surgical repair. In the region of the prostate, smooth muscle bundles were found, but no prostatic glands. Posterior to the bladder and in the region where the uterus is found in the female was a small organ showing smooth muscle on section. A lumen opened into a tube-like structure which in turn emptied into the posterior urethra at the vera montanum. This was thought to represent rudimentary cervix and vagina.

CASE II. G. S., a white male, aged twenty-six, admitted to our clinic in March, 1945, with a history of enlargement of the left testicle discovered the previous November. Since January, 1945, he had noticed weakness and 30 pounds weight loss; occasionally he had chills and fever.

On admission, masses were discovered in his neck and left supraclavicular area which were thought to be metastatic. Roentgenograms of the chest showed multiple nodular metastatic lesions and intravenous urography suggested para-aortic node involvement. A large epigastric mass was present and the patient had bilateral ankle edema. Bilateral orchiectomy was done with a pathologic diagnosis of "malignant embryoma, seminoma type."

In spite of the patient's poor condition, deep roentgen therapy was instituted according to the technique outlined by Pendergrass, Chamberlin, Selman and Horn,[12] and treatment was continued for six weeks. Following this the patient showed remarkable clinical improvement with a weight gain of 25 pounds and marked improvement in his sense of well-being. However, this lasted only about three months—then a rapidly retrogressive course started. He developed nodules on his scalp, and in September, 1945, a roentgenogram of the skull showed several metastatic areas in the calvarium (Fig. 6). These areas were quite painful, but this pain was quickly relieved by roentgen therapy in doses ranging from 800 to 1,200 r (measured in air) (200 kv., 15 ma., 0.5 mm. Cu and 1 mm. Al filtration, 50 cm. skin target distance, half-

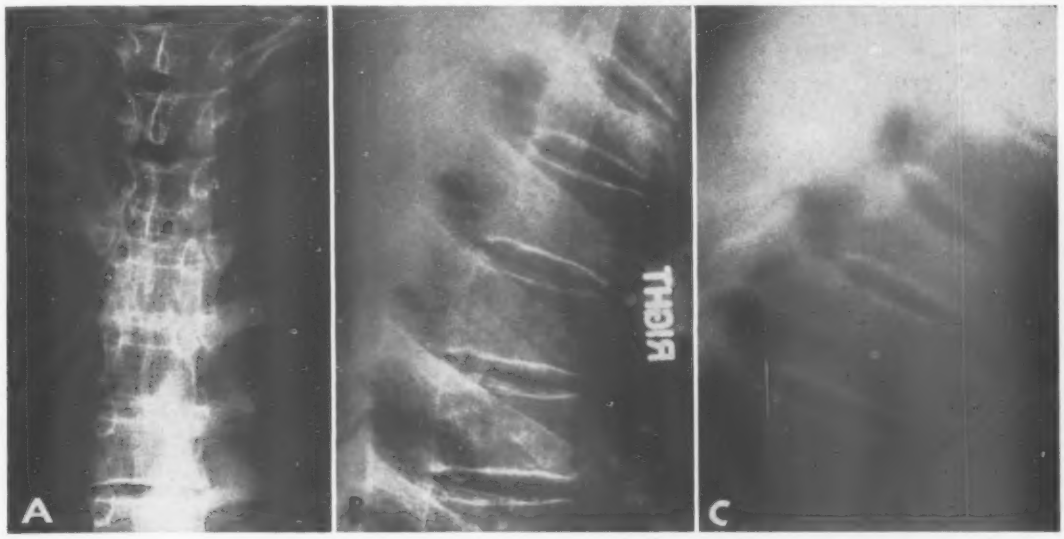


Fig. 5. Case 1. September 12, 1947. Collapse of the body of the fifth dorsal vertebra is well demonstrated by anteroposterior (*A*), lateral (*B*), and body section (*C*) roentgenograms.

value layer 1.1 mm. Al). By November his general condition was deteriorating rapidly. He died in another hospital on December 14, 1945.

Radiation therapy is now almost universally accepted as a valuable adjunct in the management of tumors of the testicle, the most common form of treatment being simple orchiectomy, ligating the spermatic cord as high as possible, followed by roentgen therapy to the lymph node areas.[1,5,9,10,11,12] This procedure has almost completely supplanted the radical operations which removed the pelvic lymph nodes.

Reviews of the cases of testicular tumors seen in our clinic from 1916 to 1945 have been published by Chamberlin and Jamison[5] and by Pendergrass, Chamberlin, Selman and Horn,[12] outlining the method of management used. In these reports it was stated that in patients with known metastatic lesions, roentgen treatment should be carried to the limit of skin tolerance. This was done in Case 1 which we are now reporting, and the severe bone pain which had been the predominating symptom was relieved completely until the patient's condition became terminal. This man had seventeen months of freedom from pain after he was first treated, and at autopsy no evidence of viable tumor could be found in the ilium. This region received a tumor dose of approximately 4,000 r (depth dose from charts by Glasser, Quimby, Taylor and Weatherwax[8]). The other areas did not receive such heavy irradiation and the process continued to grow.

Case 11 was in poor condition when he was first seen in our clinic and he did not tolerate very well the treatment which he received. However, it was clearly shown that even small doses of roentgen therapy

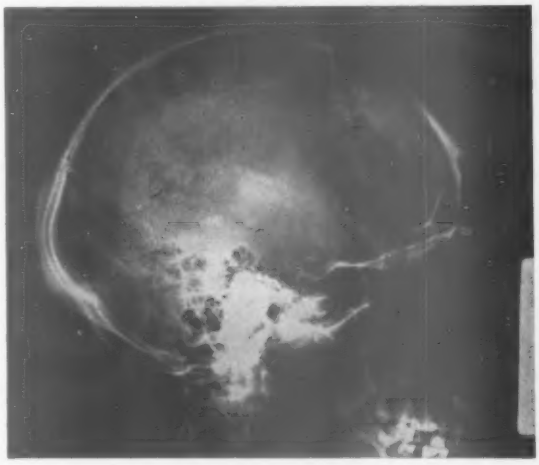


Fig. 6. Case 11. Destructive lesions are noted in the calvarium shortly before the patient's death.

such as he had to the skull lesions would relieve the pain, although he did not have enough to sterilize the tumor process.

Brunschwig and Fox[3] report a case of embryonal carcinoma of the testis with metastasis to the retroperitoneal and mediastinal nodes which received 2,326 r (air) followed by 1,094 r (air) which at postmortem showed no viable tumor cells.

The genital abnormalities present in Case 1 were such that he would be classified as a pseudohermaphrodite. The fact that patients with abdominal testes often have associated genital abnormalities has been mentioned, and these abnormalities have been better understood since Young's classic monograph[13] was published. As he points out, at the sixth or seventh week of embryonic life the gonad differentiates into either ovary or testis. If the latter develops the wolffian body and duct are stimulated into development of a vas deferens, seminal vesicle and epididymis. While this is taking place the müllerian structures disappear to remain as vestiges. Case 1 corresponds to Young's[13] Cases 7 and 8 (pp. 92 and 101). The terminology would be "male pseudohermaphrodite with uterus and vagina opening into urethra and two pelvic testes." In commenting on his Case 7, Young states: "If the two undescended testes had had the proper interstitial cells they should have arrested the development of the Müllerian ducts which went on to form uterus, tubes and a vagina." This comment also applies to our Case 1.

Malignancy in undescended testicles is so much more common than in those which are normally placed that Campbell[4] feels that any case of abdominal testis should be explored and the misplaced gonad placed in the scrotum or inguinal canal where it can be more closely observed. However, Gilbert and Hamilton[7] point out that even when ectopic testes are placed in the normal position they retain their predilection for malignancy. Therefore, if the testis cannot be brought to a point where it can be more closely observed, they believe it should be excised. They point out that very few of these testes will have spermatogenic function, and hormone therapy can be instituted.

CONCLUSIONS

1. Cancer of the testes rarely metastasizes to bone.
2. Roentgen irradiation is of definite value in controlling metastatic lesions from cancer of the testis. Sufficient tissue dose will sterilize metastatic foci, and smaller dosage is of definite value in relieving pain from bone metastasis.
3. Patients with cancer of the testis who have bone pain should receive vigorous roentgen treatment even though metastatic lesions cannot be demonstrated.
4. Abdominal testes should be removed if they cannot be brought to a position where they can be examined easily and frequently.

SUMMARY

Two cases of carcinoma of the testicle with bone metastasis are reported. One occurred in a male pseudohermaphrodite and was first discovered when metastatic lesions appeared in various bones. The second case developed bone metastasis as a terminal occurrence. The rarity of bone metastasis in carcinoma of the testicle is stressed, but the fact that pain from these lesions can be well controlled by roentgen irradiation is brought out, as is the fact that these lesions can be sterilized if sufficient irradiation can be given.

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BONE INVOLVEMENT IN CRYPTOCOCCOSIS (TORULOSIS)*

By VINCENT P. COLLINS, M.D.

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AMONG the diseases of man due to fungus infection, cryptococcosis (torulosis) is best known in the form of meningoencephalitis. As such it is probable that the earliest recorded case was that of Zenker[35] in 1861. The case of Busse and Buschke, first reported in 1894,[5] is better known and the outstanding lesion here was in bone. Despite this historically important case, bone involvement in cryptococcosis has been recognized only infrequently and, in fact, the absence of lesions in skin and bone was a differential point in first separating this entity from other fungus infections on clinical grounds.[32,34]

Cryptococcosis is widely known as torulosis. It has also been termed Busse-Buschke disease and European blastomycosis. The latter term has been used to distinguish it from North American blastomycosis due to *Blastomyces dermatitidis*, and South American blastomycosis or paracoccidioidosis due to *Blastomyces brasiliensis*. Comprehensive studies of the disease have been made by Stoddard and Cutler in 1912,[32] Freeman in 1931,[12] and Cox and Tolhurst in 1946.[9] The monograph of the last authors includes an extensive review of the literature. Greening and Menville[13] reviewed the roentgen findings in pulmonary involvement in 1947.

MYCOLOGY AND PATHOLOGY

The causative organism, *Cryptococcus neoformans*,[8] is also termed *Cryptococcus hominis*, *Torula histolytica*, and in the older literature a great variety of other names applied by different observers. The organism belongs to the group of fungi imperfecti. Both in tissue and in culture it appears as encapsulated, rounded budding cells, usually 5 to 8 microns in diameter, producing no mycelia or spores. This appearance is particularly important because the organisms have frequently been mistaken for lymphocytes or red blood cells.

A distinctive gross feature of lesions due to *Cryptococcus neoformans* is the gelatinous or mucoid character of the exudate, a finding which has often given the impression of myxomatous tumor tissue. When meningitis is present the brain has been described as "slimy." In discussing the tissue changes in fungus diseases, Baker[1] groups cryptococcosis with histoplasmosis in the group in which suppuration is usually absent. Mallory[22] has commented on the striking paucity of reaction in many cases.

The frequency with which the coincident diagnosis of Hodgkin's disease and cryptococcosis has been made[4,9,12,14,22,30,33] should be noted in considering the pathology of this infection. A discussion of this aspect is not pertinent to the present report except to suggest that closer investigation of atypical cases of Hodgkin's disease should disclose further instances of cryptococcosis.

PREVIOUSLY REPORTED CASES WITH BONE INVOLVEMENT

A review of over 200 reported cases of cryptococcosis has revealed 17 examples of bone involvement. In 4 additional cases[17,19,23,34] there was an associated mastoiditis suggestive of infection due to the cryptococcus but this was not proved.

1. The Busse-Buschke case.[5] The several independent reports of these authors are at variance on details of history and mycology and this summary is taken from Rickett's[28] review of the case in 1901. The patient was a thirty-one year old woman and the presenting lesion was in the tibia, although it is uncertain whether the primary manifestation was in ulcers of the skin of the face or in the swelling of the tibia. The tibial lesion resembled a gumma or sarcoma and

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from it a glairy fluid was obtained which on culture yielded a yeast-like organism. The knee joint became involved and later lesions appeared in the ulna and rib. At autopsy lesions were also found in lung, kidney and spleen. Cultures of the organism were preserved, and obtained for study by Benham[2] through the American Type Culture Collection at Chicago.

2. Brewer and Wood,[3] 1908. Several spinous processes were involved with extensive abscess formation in muscle. An apparent cure resulted after surgery on two occasions. The organism was identified as blastomycete but the cultural characteristics conform to those of *Cryptococcus neoformans*. There were no roentgenograms.

3. Rappaport and Kaplan,[27] 1926. This was a disseminated infection and at autopsy the bone marrow "contained clear gelatinous material" presumed to be foci of cryptococci. There were no roentgenograms.

4. Cleland,[7] 1927. This case occurred in 1915 but was not reported until 1927. There was an abscess in the region of the right iliac crest. On incision and drainage a large amount of gelatinous material was obtained in which yeast-like organisms were identified. The gross and microscopic characteristics were compatible with cryptococcus but the organism was not cultured. There were no roentgenograms.

5. Semerak,[29] 1928. This is a report of the findings on postmortem examination of the head only. There was erosion of the floor of the middle fossa bilaterally due to extradural masses of granulation tissue.

6. Hirsch and Coleman,[15] 1929. This was an instance of central nervous system and pulmonary involvement and at autopsy erosion of the inner tables of the greater wings of the sphenoid was described. There were no roentgenograms of the skull.

7. Smith and Crawford,[30] 1930. The primary symptom was pain in the left shoulder and arm for about one year. They report, "Radiography inconclusive, but suggesting osteogenic sarcoma of the anterior border of the left scapula." Biopsy suggested Hodgkin's granuloma. The scapular swelling disappeared after deep radiotherapy. The patient died one year later with central nervous system involvement and the diagnosis was based on clinical and histopathologic grounds. At postmortem "no sign of the original lesion was found. Left scapula normal." Review of the biopsy of the scapula "showed a few scattered degenerate torula." Roentgenograms of the scapular lesion were not reproduced.

8. Freeman,[12] 1931. One of the cases reported was a widely disseminated infection and at autopsy lesions were identified in the bone marrow.

9. Carter,[6] 1934; Kessel and Holtzwart,[18] 1935. This was apparently a primary infection in the region of the left knee and "produced a large granulomatous mass of neoplastic appearance, involving bone, articular structures, and skin." The lesion was described as showing "marked invasiveness." Following arthrotomy there was metastatic spread to both breasts. This responded to radiotherapy but the lesion in bone failed to heal and a mid-thigh amputation of the leg was necessary. The surgical pathology was not reported. The patient was apparently free of disease one year later. This is the first article containing a reproduction of a roentgenogram of bone involvement.

10. Ducuing, Bassal and Miletzky,[11] 1937. A seventy-five year old woman had a tumor at the superolateral margin of the right orbit which grew to the size of a walnut in two weeks. The overlying skin was intact. The tumor seemed fluctuant and evidently involved underlying bone.

Roentgenograms, which were not reproduced, were described as showing loss of bone substance of the orbital margin. Clinically it suggested a metastatic neoplasm but no primary source could be found. Aspiration yielded a brick red, thick material containing yeast-like organisms. It was treated by incision and curettage. Histopathologically it was made up of granulation tissue with numerous giant cells, polymorphonuclear leukocytes, eosinophiles and macrophages and many encapsulated "parasites" (yeast cells). The presence of *Cryptococcus neoformans* was established by culture. The patient was well eight months later.

11. Dienst,[10] 1938. "On examination a tumor about 4 cm. in diameter was found attached to the 10th rib on the right side just below the angle of the scapula. A roentgenogram showed erosion of the 10th rib in the region of the growth. The tumor gave the impression of sarcoma." A pure culture of cryptococcus was obtained from the biopsy specimen. The patient was given roentgen treatment and potassium iodide. The wound healed and six months later she had had no recurrence and appeared well. The roentgenogram was not reproduced.

12. Longmire and Goodwin,[20] 1939. In a widespread generalized infection there were several soft areas, 5 or 6 mm. in diameter, in the bones of the middle fossa of the skull filled with a yellow gelatinous material similar to that in the meninges. This was an autopsy finding and there were no roentgenograms recorded.

13. Heine, Lauer and Mumme,[14] 1940. This patient initially had a cervical lymph node removed and the diagnosis was "lymphosarcoma or possibly early lymphogranuloma." The autopsy diagnosis was "generalized blastomycosis and lymphogranulomatosis." The eleventh thoracic vertebra showed a destruction that was interpreted as due to "granulomatosis" (Hodgkin's disease) with the presence of yeast cells. There were no roentgenograms.

14. Burger and Morton,[4] 1944. In 1 of 4 cases reported there was gross postmortem evidence of bone involvement in a widely disseminated infection. There were no roentgenograms.

15. Mider, Smith and Bray,[24] 1947. This case was a generalized mixed infection by *Cryptococcus neoformans* and *Histoplasma capsulatum*. There was a red, painful swelling over the right sternoclavicular joint which yielded a yellow mucoid material on drainage.

At autopsy the sternoclavicular joint space was filled with cryptococci and a few intracellular histoplasmas. Two-thirds of the articular surface of the clavicle was eroded and both organisms were present throughout the clavicular marrow. There was an 8 mm. lesion in the tenth thoracic vertebra which contained a large number of cryptococci and a few histoplasmas. There was also a 1.7 cm. lesion in the left frontal bone but only the gross appearance was described. The roentgen appearance of the osseous lesions was not recorded.

16. Jesse,[18] 1947. The initial symptom was pain in the right hip and roentgenograms showed a 2 cm. "cyst" in the inferior ramus of the right pubis. A chest roentgenogram at the time suggested the possibilities of tuberculosis or coccidioidosis. The lesion in the pubic bone increased in size and showed a small amount of new bone formation. Biopsy established the diagnosis of cryptococcosis. The inferior ramus of the pubis was resected and the patient was reported well fourteen months later. Roentgenograms of the lesion were reproduced in this report.

17. Neuhauser and Tucker,[25] 1948. In 1 (Case II) of the 3 cases reported there were numerous organisms in the bone marrow. Roentgenograms of long bones showed well defined zones of submetaphyseal rarefaction, with some sites of actual loss of bone trabeculae. The authors considered the roentgen findings as being nonspecific.

CASE REPORTS

CASE 1. B. T. (Unit No. 472723), female, aged twenty-seven. Following delivery in November, 1934, there was a profuse foul vaginal discharge. During the next year there were four admissions to other hospitals for an undiagnosed infection manifested by persistent high temperature, chills, endometritis, phlebitis, abscesses of the scalp, osteomyelitis of the cranium, pain in the legs, shoulders and hands, increasing weakness, and 45 pounds weight loss. On admission to The Presbyterian Hospital December 12, 1935, there was a partially healed incision in the frontal region and a 3 cm. punched out ulcer in the left temporal region. There was tenderness over the greater tuberosity of the right humerus, right iliac crest, and pubic bones. Heart, chest and neurological examinations were essentially negative. Roentgen examination on December 13 showed multiple

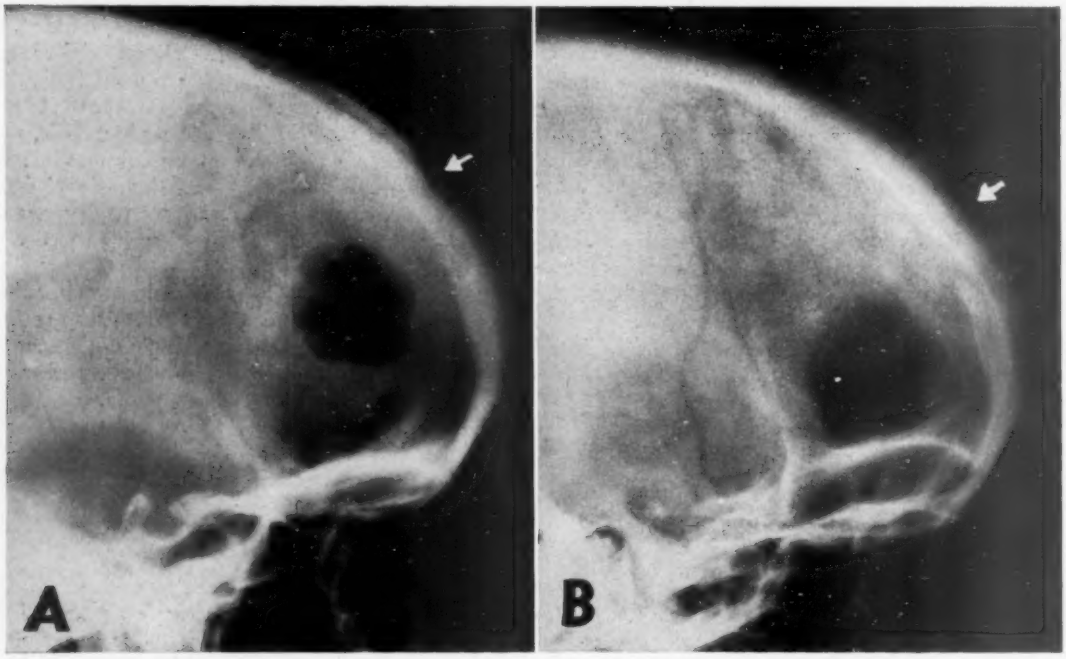

FIG. 1. Case 1. (*A*) Roentgenogram of the skull, December, 1935. The lesions are sharply defined without marginal new bone formation. The defect shown in profile demonstrates that the greater extent of the destruction is in the outer table. (*B*) March, 1937. The lesions have increased slightly in size and the margins are less well defined. These lesions were deep to cutaneous ulcerations when the patient was first seen. At the time of death the ulcers were healed but there were palpable underlying depressions.

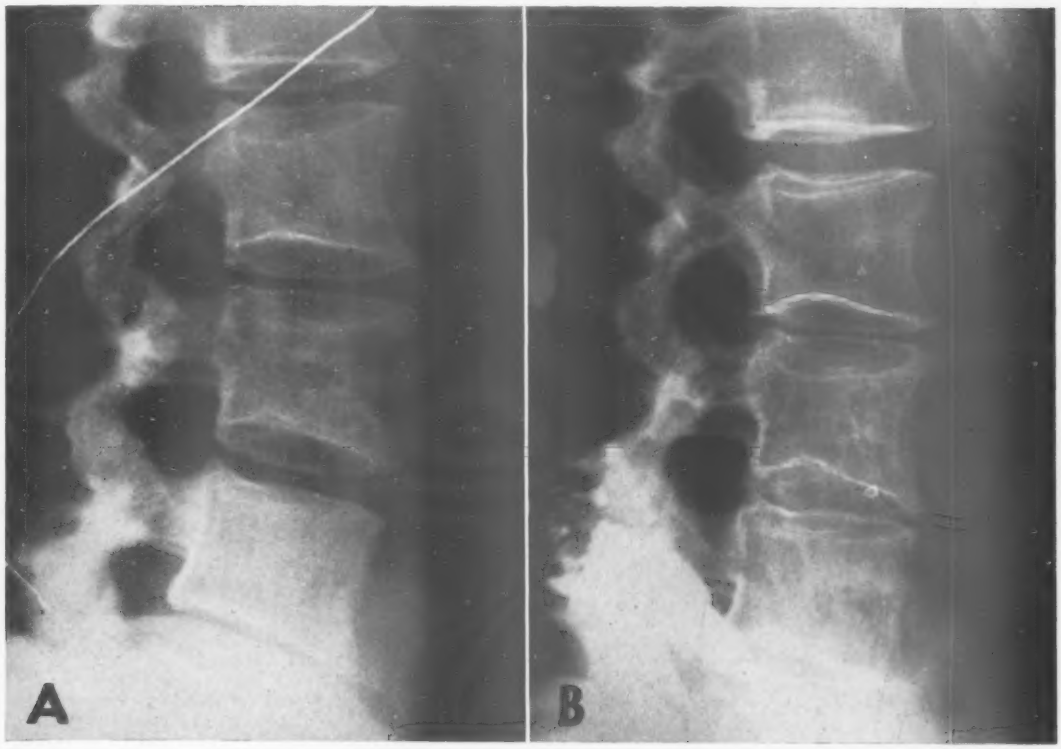

Fig. 2. Case 1. (*A*) Lumbar spine, January, 1936. The bodies of the second, third, and fourth lumbar vertebrae are involved, but the destruction is best demonstrated in the third. There is cortical erosion without osteoblastic reaction of soft tissue calcification. (*B*) March, 1937. The defect in the anterior margin of the third lumbar vertebra has partially filled in. The abscess in the lumbar musculature is outlined by lipiodol. Postmortem examination of the vertebral bodies showed no bone proliferation and the marrow of the vertebrae was described as normal.

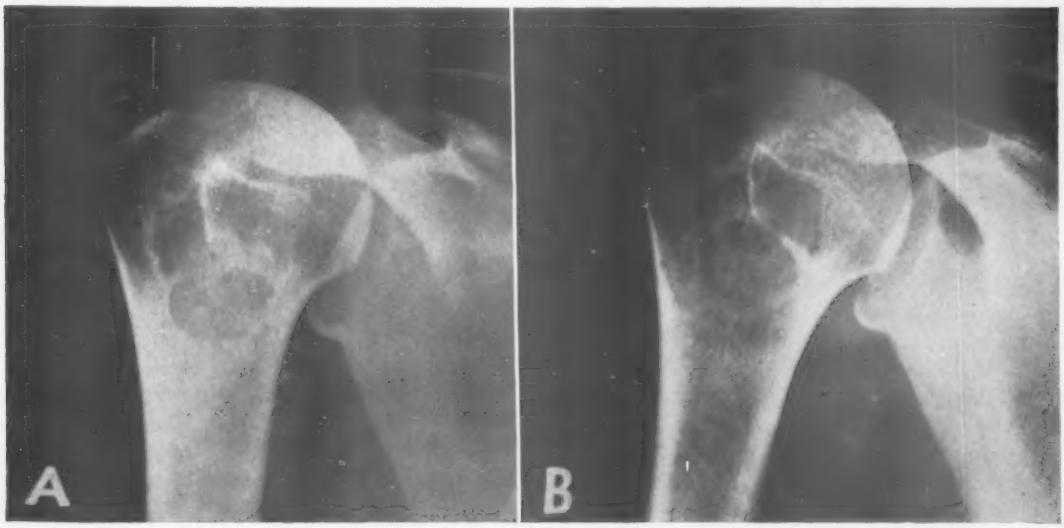

Fig. 3. Case 1. (*A*) Humerus, December, 1935. The area of bone destruction has a sharp scalloped margin without bone reaction. (*B*) March, 1937. The margins are indistinct and the lesion has enlarged, extending along the marrow cavity. There is no evident periosteal reaction although there were draining sinuses in the axilla.

areas of bone destruction in the skull, upper end of the right humerus, body of the third lumbar vertebra, right iliac wing, and both ischial tuberosities. A chest roentgenogram showed widespread peribronchial infiltration. *Cryptococcus neoformans* was identified by culture of material from the lesion in the right ilium. She was treated by iodides per os and locally, hyperthermia, radiotherapy, and transfusions. Abscesses of iliac, lumbar and axillary regions were repeatedly aspirated. There was some symptomatic improvement and it was possible to allow her home for a period. In January, 1937, roentgen examination showed some decrease in size in some of the bone lesions but new areas of bone destruction had appeared in right humerus and femora. The peribronchial infiltration had increased in degree. Massive abscesses in both psoas regions required surgical drainage. Neurological examination on April 5, 1937, suggested a basilar meningitis. Cerebrospinal fluid contained 110 "red blood cells" per cubic centimeter, but the results of culture were not recorded. The patient died on April 20, 1937, in mild uremia and with hemorrhage from multiple drainage wounds.

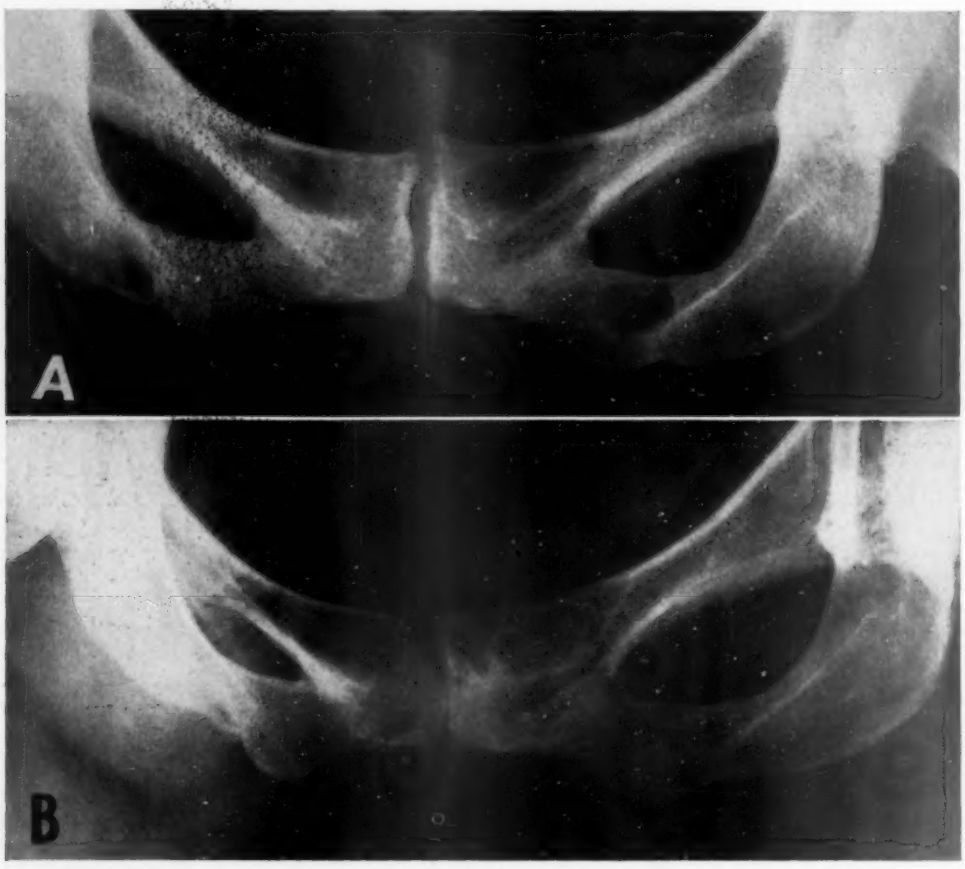

FIG. 4. Case 1. (*A*) Pelvis, December, 1935. The symmetrical lesions involving the ischii are purely osteolytic. (*B*) March, 1937. The lesions have diminished considerably in size without increase in density of the adjacent bone. The soft tissue shadow in the right inguinal region represents a psoas abscess which was drained three days later, yielding 750 cc. of thick pus.

Autopsy. The final autopsy diagnosis was generalized cryptococcosis. Permission for examination of brain and cord was not obtained. The outstanding histopathologic feature was the presence of tubercle-like structures in lung, spleen, liver, kidney, bone marrow and wall of sinus tract. These consisted of mononuclear epithelioid cells and one or more multinucleated giant cells. In the cytoplasm of these cells, or

free in the stroma, were unstained particles, sometimes calcified. Oval bodies, sometimes budding, with no mycelia were seen but these were not numerous. These did not show recognizable capsules. Some showed calcification and the periphery stained more deeply than the centers. They were usually separate from the tubercle-like structures. They were interpreted as cryptococci and the particles in the tubercles were considered to be remnants of cryptococci or substances derived therefrom.

over the right shoulder was incised and drained, and yellow gray pus was obtained. Routine culture showed no growth. On April 10, roentgenograms showed well defined areas of bone destruction in the spine of the right scapula and alae of the iliac bones bilaterally. The diagnosis of fungus infection was suggested on these films. Roentgenograms of the chest showed a pleural effusion on the left and some peribronchial infiltration in the right base. On May 5, the abscess of the right shoulder was

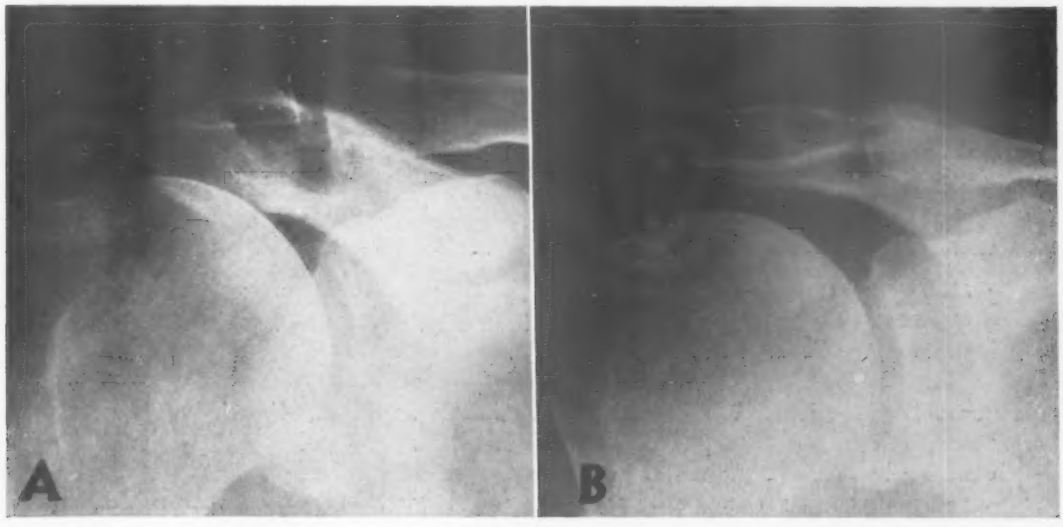

Fig. 5. Case 11. (*A*) Right shoulder, April, 1945. There is a well defined area of destruction in the acromion with no associated bone reaction. (*B*) September, 1945. The area of destruction is somewhat smaller, but still without evident sclerosis or periosteal reaction.

The organism was not recovered culturally although it had been readily isolated from numerous sinuses during life.

Case 11. P. C. (Unit No. 779717), male, aged fifty-four. In January, 1945, this patient was admitted to another hospital because of pain in the right shoulder and right hip, headache, and persistent sore throat. He was treated with penicillin with symptomatic improvement and discharged in two weeks. He was admitted to The Presbyterian Hospital on March 22, 1945, with a very severe headache, stiff neck and general malaise. As well as signs of meningeal irritation, there was a soft, fluctuant mass, 10 by 15 cm., over the right shoulder. Cerebrospinal fluid showed an initial pressure of 230 mm. of water. There was no growth on routine culture and the results of smear or cell count were not recorded. On March 28 the abscess reopened and some of the lining granulation tissue submitted for examination. *Cryptococcus neoformans* was identified in this material. During this period the signs of meningitis had cleared but in the next three months abscesses developed in the cervical, lumbar, and sacral regions, and an area of bone destruction was demonstrated in the pedicle of the fourth thoracic vertebra. *C. neoformans* was constantly recovered from the abscesses. In August it was discovered that an antibiotic, protoanemonin, was effective against the organism in vitro. Instillation of this substance into the abscess cavities was begun. There was an episode of left femoral thrombophlebitis in September but this subsided in a week. Suddenly, on October 31, 1945, he complained of very severe substernal pain, became comatose and cyanotic, and died within fifteen minutes.

Autopsy. The only lesions due to the crypto-

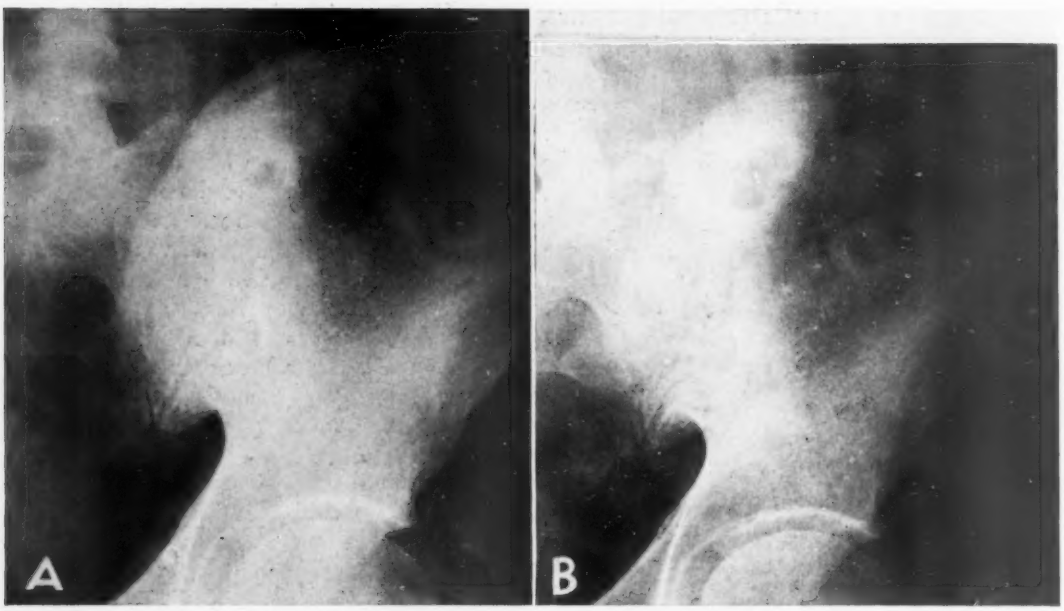

FIG. 6. Case II. (*A*) Pelvis, April, 1945. There are two areas of bone destruction in the ala of the left ilium. The margins of these lesions do show an increase in density. (*B*) September, 1945. In the interval one lesion has enlarged and a new lesion has appeared.

coccus were abscesses in skeletal muscle and bone. Smears of the contents of these abscesses contained typical cryptococci but no growth was obtained on culture, and no cryptococci were identified in histologic preparations. Sections of the abscess walls showed granulation tissue with all types of inflammatory cells. Some multinucleated giant cells contained refractile bodies.

No lesions due to the cryptococcus were identified in the brain but sections from the cerebral cortex showed degenerative changes.

CASE III. A. C. (Courtesy of Dr. J. W. Pierson, Baltimore, Md. Johns Hopkins Hospital Unit No. 294622), colored, female, aged twenty. During a two and a half year period prior to admission the patient developed an increasing fatigability, anemia, amenorrhea, loss of axillary and pubic hair, ankle edema, and dryness of the skin. A biopsy of a lymph node indicated Boeck's sarcoid and it was thought that bones, lungs, lymph nodes, skin, liver, and possibly the pituitary gland were involved. Three months before admission she noted the onset of pain in the right tibia, and one month before admission roentgen examination revealed lesions in the tibia and left ischium (Fig. 7 and 8). She was admitted to the Johns Hopkins Hospital on March 17, 1948. A biopsy of the tibial

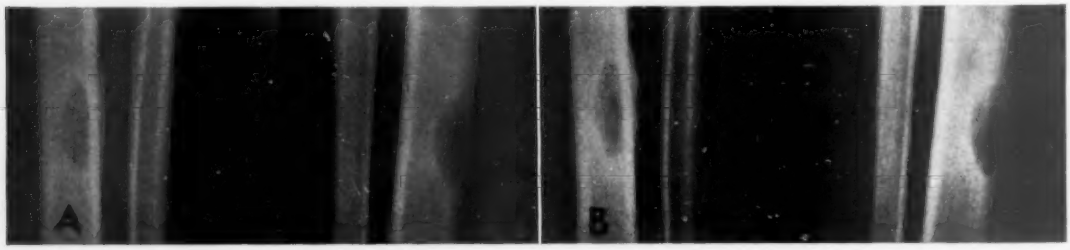

FIG. 7. Case III. (*A*) Tibia, February, 1948. Anteroposterior and lateral projections show a well defined lesion without marginal increase in density of bone, but with periosteal new bone formation. (*B*) March, 1948. In one month there was no appreciable change in the size of the lesion or in the degree of periosteal reaction.

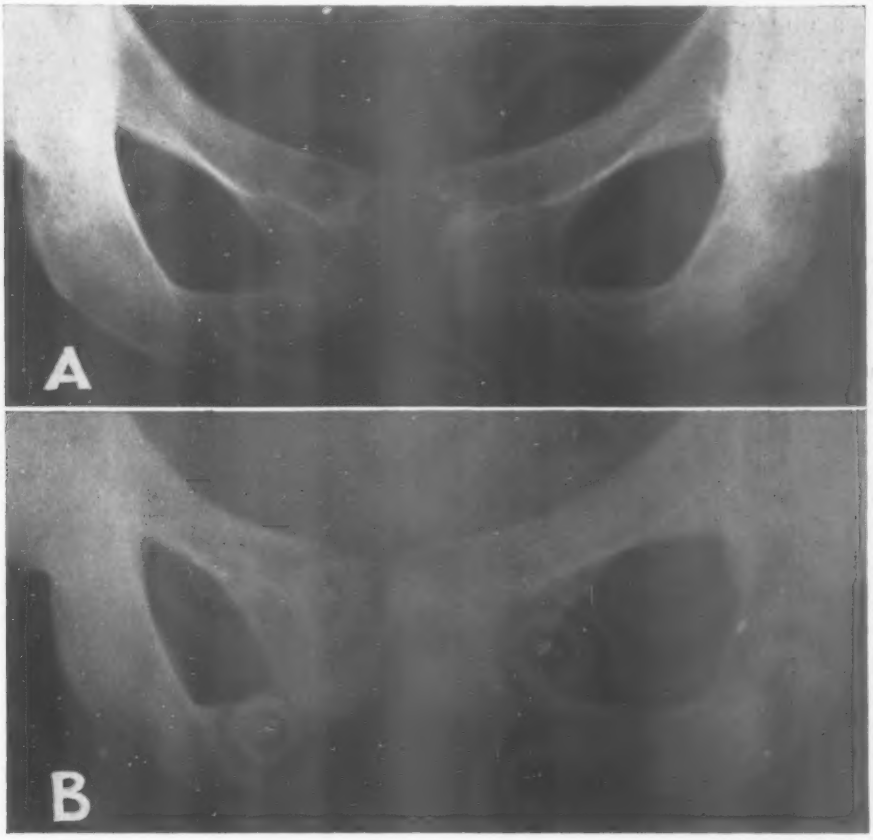

Fig. 8. Case III. (*A*) Pelvis, February, 1948. There is a lesion in the left ischial tuberosity, and possibly one on the right. The margins are not clearly defined. (*B*) March, 1948. There has been a definite increase in the extent of the lesion in the left ischium.

lesion revealed a granulomatous reaction with yeast-like organisms in giant cells and scattered throughout the tissue. It was not certain whether this was a torula, blastomycete, or monilia. Culture of a skin lesion in the perineum yielded *Cryptococcus neoformans*. The infection proved resistant to potassium iodide, penicillin, streptomycin, sulfadiazine, and sulfamurazine. A large fluctant mass developed over the right ischium. During the last two weeks of life the patient exhibited increasing signs of meningitis. A lumbar puncture revealed 40 mononuclear cells per cubic millimeter. Culture for fungi was not reported. She died on July 5, 1948.

Autopsy. The final autopsy diagnoses were cryptococcosis involving meninges, ependyma, brain, kidney, adrenal, lung, bone and subcutaneous tissues; sarcoidosis involving lung, heart, lymph nodes, liver, spleen and hypophysis; Simmons' disease with cachexia, atrophy of breast, ovary and adrenal cortex, and loss of pubic and axillary hair.

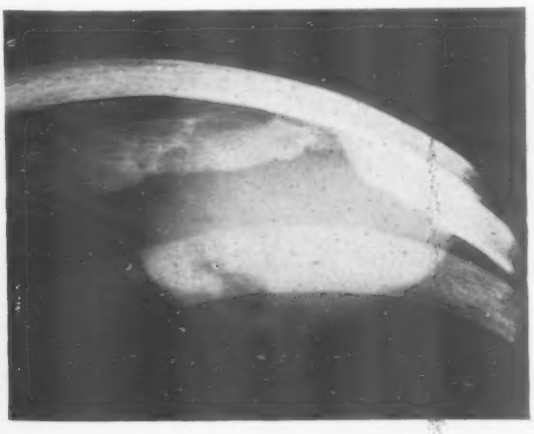

Fig. 9. Case III. Autopsy specimen of abscess of chest wall. This illustrates well the dissolution of bone that occurs without exciting reactive bone formation.

There was a disseminated nodular infiltration of lung, liver, spleen and renal cortices, a generalized thoracic and abdominal lymphadenopathy, abscesses involving the left side of the pelvis and the right chest wall, and purulent meningitis.

The sarcoid involvement was considered to be characteristic. There were numerous giant cells containing refractile bodies and Schaumann bodies, some of which were calcified. The hypophysis was virtually replaced by such sarcoid tubercles. The bodies recognized as organisms were similar to those in Case I. They stained irregularly, the periphery staining more deeply than the central portion, and some suggested calcification. Distinct capsules were not recognized.

DISCUSSION

These 3 cases and the other examples which have been reviewed are quite inadequate to establish a characteristic roentgen appearance for bone involvement in cryptococcosis. However, there is some value in a comparison with the bone lesions occurring in other mycoses. The most important of these are blastomycosis (*B. dermatitidis*), coccidioidosis and actinomycosis.

The roentgen appearance of the bone lesions in blastomycosis were classically described by Potter[26,31] with excellent illustrations. He pointed out the marked local destruction of bone with little evidence of reaction in adjacent bone, but attended by a well marked periosteal proliferation of new bone.

Carter[6] analyzed the roentgen features of bone involvement in 70 cases of coccidioidosis in 1934. He felt that Potter's description applied equally well to both diseases. The lesions were similar in type and distribution and both frequently involved joints secondarily. He pointed out a predilection for bony prominences and noted that in this respect these lesions differ from the non-mycotic infections of the bone. Although periostitis was a frequent and prominent feature it was not a constant accompaniment. He described lesions which were purely osteolytic without periostitis. In the skull the lesions were circular or irregular involving the outer table or both tables. The degree of destruction may be greater in the outer table but the reverse was not seen.

In actinomycosis bone involvement is usually secondary to infection in soft tissues localized in the cervicofacial, thoracic or abdominal regions. Carter[6] states that actinomycosis in any site shows an even greater tendency to produce periosteal reaction than does blastomycosis or coccidioidosis. When vertebrae are involved the roentgen findings may be characteristic.[21] Cortical involvement with periostitis may produce a typical "saw-tooth" appearance of the anterior vertebral margin, but involvement of all portions of the vertebra is a feature. The infection tends to riddle the bone, and osteoblastic reaction adjacent to areas of destruction produces a mottled appearance so that the vertebra appears denser than normal.

In the cases of cryptococcosis reviewed and reported here the osseous lesions, when multiple, were widely disseminated and discrete. They tended to be purely destructive, exciting little or no reaction in bone or periosteum. There are several examples of involvement of bony prominences. The lesions were chronic and any change occurred slowly. Progression of a lesion was by a fairly even enlargement of an area of bone destruction. Regression is apparently possible with the reformation of bone of normal structure. It may be that the slow rate of change in these disseminated areas of bone destruction is a significant feature in the recognition of the disease.

The bone lesions in the 3 cases of cryptococcosis of this report fall within the range of variation described by Carter as common to blastomycosis and coccidioidomycosis. These three mycoses differ from actinomycosis in both the distribution and character of the osseous lesions. In the former the lesions are disseminated and discrete whereas in actinomycosis the infection tends to extend by direct continuity, riddling the regional bones.

Although the histopathologic appearance in Cases II and III showed some similarity,

the interpretations differed. Both cases might have been interpreted as examples of cryptococcosis and sarcoid or as cryptococcosis alone. This is the same problem that has been encountered in the association of cryptococcosis and Hodgkin's disease. Cultural investigation of material from both Hodgkin's disease and sarcoid might add to the available information on this interesting association.

SUMMARY

Seventeen instances of bone involvement were encountered in a review of over two hundred cases of cryptococcosis which have been reported in the literature. Three additional cases with bone involvement are reported with roentgen observations over periods up to fifteen months. The lesions, when multiple, are widely disseminated and tend to involve bony prominences. They tend to be osteolytic, exciting very little bone reaction. Any change occurred slowly and both progression and regression were observed. When compared with other mycoses commonly involving bone, the roentgen appearance of bone involvement due to cryptococcosis more closely resemble that due to blastomycosis (*B. dermatitidis*) and coccidioidosis than that due to actinomycosis.

Attention is directed to the reported cases of cryptococcosis associated with histopathologic characteristics indicating Hodgkin's disease and sarcoid.

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DEPARTMENT OF TECHNIQUE

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A SIMPLE METHOD OF IDENTIFYING MULTIPLE FOREIGN BODIES ABOUT OR IN THE EYE FOR LOCALIZATION

By E. L. SHIFLETT, M.D.
LOUISVILLE, KENTUCKY

THE localization of intraocular foreign bodies by the principle of lateralization leaves much to be desired. This problem becomes crucial in time of war. The explosion of a missile may drive numerous small shell fragments, varying from less than a millimeter to several millimeters or more in size into the globe and/or into the surrounding tissue of the orbit and face. Such wounds are often bilateral and this makes the problem even more difficult. Intraocular foreign bodies, foreign bodies in the orbital soft tissue, and those on the opposite side of the face may be visualized in a group in the lateral plane of the eye. These metallic foreign bodies often have

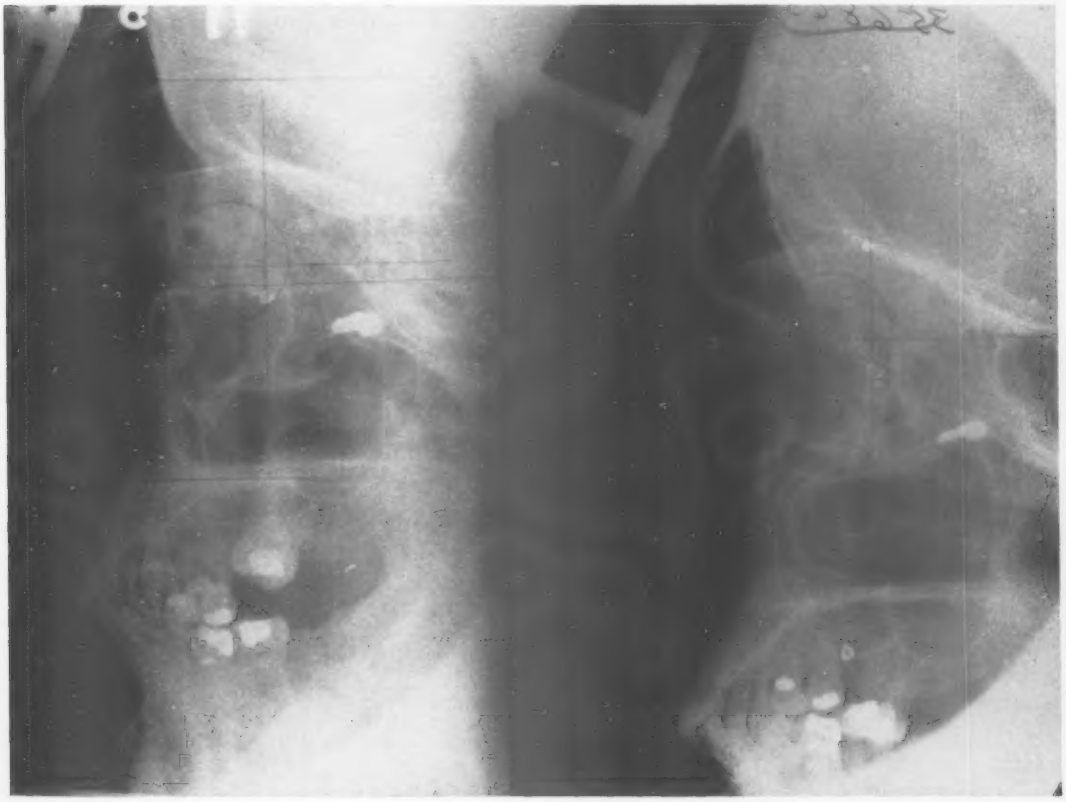

Fig. 1. Simple problem of identification and localization.

no characteristics which permit identification, and identification is a prerequisite to localization.

The posteroanterior preliminary roentgenogram will often show two or more metallic foreign bodies which are almost certain to be in the eye but are extremely difficulty to identify among so many on lateralization films. This is quite discouraging to the roentgenologist and to the opthalmologist, particularly, when there is a chance to save some sight in one eye when the other has been completely destroyed. It is an unpardonable cruelty to the individual to let the great number of foreign bodies deter a serious and honest attempt at localization. We recall in particular one case in which the posteroanterior preliminary film showed three small bodies which appeared to be in the globe. These were surrounded by numerous shell fragments and shell dust in the orbit, face, and skull so that when lateralization films were made these three had to be identified from as many as 138 small metallic foreign bodies which were projected in the same field. The problem at first seemed impossible, and led to the development of the method of identification described below. Identification and localization of these three bodies required six hours of the most tedious study. They were however, localized, and the effort was rewarded by the surgical removal of two of the bodies. The third, which was less than 1 millimeter in diameter, was well out toward the periphery of the eye and was questionably in the outer coat or intraocular. This one could not be found at time of operation.

The method we evolved is a simple procedure and it was of such great aid to us in the identification of foreign bodies that we

FIG. 2 (*A*) Vertical section: Foreign body A well below eye; foreign body B within area of globe. (*B*) Horizontal section: Foreign body A projected over area of globe, but position on vertical section establishes this out of the eye. Foreign body B must be localized in usual manner. The similar shape and nearness of planes back of cornea might lead to confusion of identification.

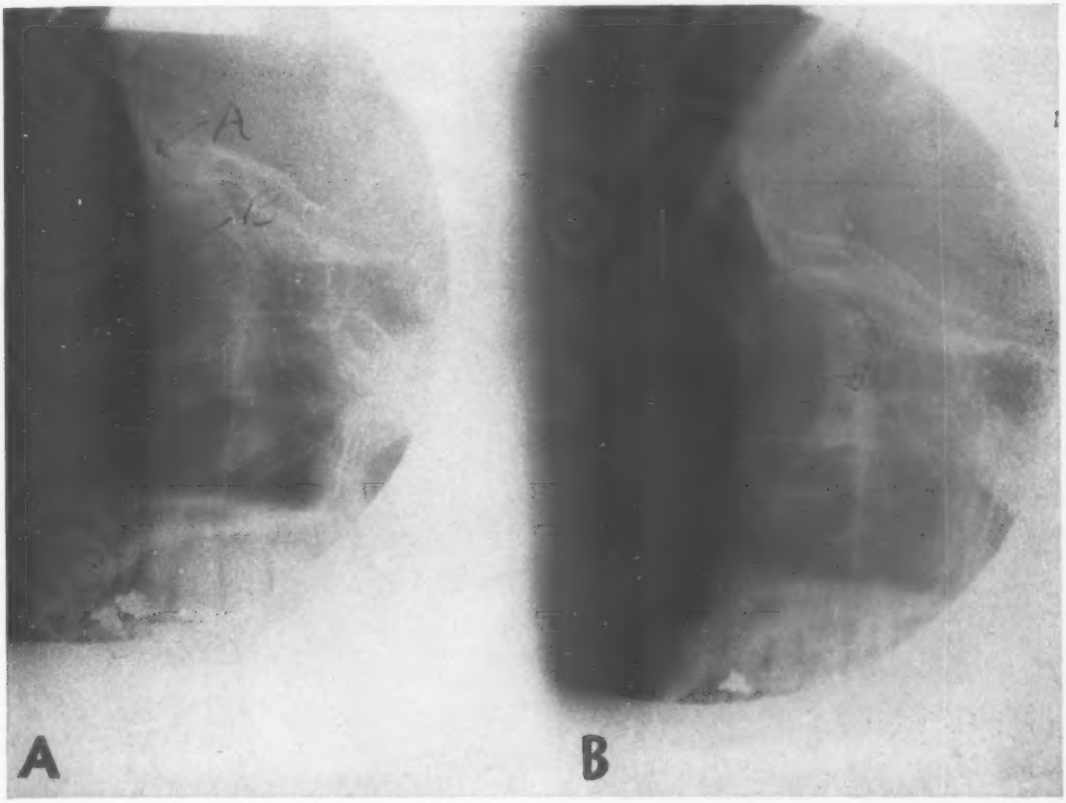

Fig. 3. (*A*) Vertical section: Foreign bodies A and B in plane of globe. (*B*) Horizontal section: Foreign body A projected well up over frontal area and obviously out of eye. Parallel planes correctly identify the foreign body which must be localized.

feel it is worth while to describe and record it.

The horizontal plane of the cornea is projected from the ball of the Sweet localizing apparatus, vertical section, and on this plane is constructed a theoretical globe 25 mm. in diameter, the anterior summit of the circle being exactly 10 mm. removed from the ball. This establishes with a fair degree of accuracy the position of the summit of the cornea and the horizontal plane of the eye. The same procedure is repeated on the horizontal section, again using the ball to establish the horizontal plane of the eye and the summit of the cornea. We felt that this could be done since the shifting of the tube caudad should not change the relative planes of the ball, cornea, and foreign bodies. Next, a perpendicular line is constructed to the horizontal plane of the cornea and passing through the foreign body as shown in the vertical section of the Sweet series. A similar perpendicular is then constructed on the horizontal section exactly the same distance from the ball, but without reference to the position of the foreign body. The fact that the perpendicular is constructed to the horizontal plane of the eye and through the foreign body on the vertical section, and only to horizontal plane on horizontal section at the same distance from the ball but ignoring the position of the foreign body serves as a control. If more than one foreign body is present the most anterior is selected first, proceeding from ventral to dorsal. This results in a series of parallelograms equidistant from the ball on both sections and perpendicular to the horizontal axis of the eye. It is then easy in the majority of cases to identify the multiple bodies by their relationship to the circle and to the parallel planes. If the foreign body in the same parallel plane falls in the circle on one section but out of it

FIG. 4. Only foreign body A can be in globe and needs localization. The simple method of identification makes localization of the foreign body a simple procedure.

on the other, it is almost certain to be extraocular, it having been projected on the globe by reason of being at a greater distance from the film, lateral or mesial to the eye, or projected from the opposite side of the face. Those which are in the same parallel planes and fall within the circle on both sections are most probably intraocular and these must be localized in the usual manner. To avoid the possibility of a foreign body being in a larger than normal average eye, and to allow for possible error in the reconstruction of the position of the eye, all bodies 2 to 3 mm. beyond the circumference of the circle are also localized.

The above described procedure greatly simplified our problems of identification and in most cases the entire procedure could be carried out in less time than it has taken to describe it. This method should also aid in the localization of multiple symmetrical foreign bodies in or about the globe, a condition which will occur occasionally in civilian practice, as for example, gunshot wounds with buckshot of the orbit and eye, difficult to localize because the uniformity of the shot in size and shape makes identification difficult.

We emphasize again that we present this method only as an aid in identification when multiple foreign bodies are superimposed upon the area of the eye on lateralization films. It must not be used in any way as a method of actual localization of the position of the foreign body in the eye. Localization, however, cannot be performed without accurate identification of the foreign body to be localized.

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Fifty-first Annual Meeting: Jefferson Hotel, St. Louis, Mo., September 26–29, 1950.

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Thirty-second Annual Meeting: Roosevelt Hotel, New York, N. Y., May 25–26, 1950.

EDITORIAL

THE COMMUNITY HOSPITAL AND THE SPECIALTIES

AFTER more than thirty years as radiologist in a large teaching hospital where my consultants were specialists in other branches of medicine, I have been for the past three years working in a small community hospital where the consultants have been almost entirely general practitioners. This latter experience has led to a clearer understanding of what is expected of the general radiologist and of what his training should be to the end that he may be fitted to carry on his job well. In view of the recent controversy among teachers of radiology, especially that part of the problem which applies to therapeutic radiology, it is possible that the ideas gained in a rather unusual experience may be of some value to those who are responsible for training in the specialty at the present time.

One has to work for a time away from the larger teaching centers to realize the great need for trained men in radiology and surgery in our community hospitals. The rapid growth of these hospitals throughout the country is changing the practice of medicine in these communities. Most of these hospitals are well managed and well equipped. Good operating and laboratory facilities are available as well as modern roentgenologic equipment. They are staffed by conscientious, hard-working general practitioners who are doing an excellent job in their field. The staff is not, however, trained to take advantage of many of the facilities which the hospital has to offer, nor is it possible for them to acquire the technical knowledge which the examining boards now require. They can no longer become certified radiologists or surgeons by experience in practice or the taking of postgraduate courses. The residences which the boards require they do not have and cannot obtain. The establishment of examining boards in the specialties has done much to raise the standard of practice and of teaching in the specialties. This work should go on, but the teachers should not lose sight of the fact that nine out of ten of their graduates must practice their specialty in a community hospital if they are to meet the medical needs of the people.

Just what does this mean to the head of a department in our large teaching hospitals? He should, as Dr. Merrill C. Sosman pointed out some time ago,* so arrange his curriculum that the residents in his department will obtain a working knowledge of his specialty in all its branches; he should not attempt to make them experts in all the subdivisions of the specialty. Radiology like surgery is a broad specialty. Fortunately, it has not yet been divided into subspecialties, which has been the way in which surgery has developed. We are a much younger specialty and should profit by the mistakes of those who have preceded us. Certainly there is a trend among medical teachers at the present time to insist on a good training in the general field of a specialty before taking up one of the subspecialties. Teachers in general should realize that they are not expected to turn out a finished product. The successful practitioner of medicine in any of its branches must remain a student all his active life. It is important that the student during his training period should master the basic principles of sound medical practice, become familiar with its literature, and be well trained in the technical procedures

* Sosman, M. C. Specialization within Roentgenology. AM. J. ROENTGEOL. & RAD. THERAPY, 1940, *44*, 645–648.

of his specialty. He should be given increasing responsibility and should be encouraged to check his observations whenever possible. Judgment will come with experience. Right thinking, accurate observations, and a technique that cannot be criticized are more important to the student than the accumulation of a number of facts which will probably be out of date in five years. In radiology the resident at the end of three years should be competent either to accept a position as assistant in a large teaching hospital, to enter the private practice of general radiology, or to accept a position as radiologist in a community hospital. He should not be expected, without supervision, to undertake the more difficult specialized procedures, such as the radiation treatment of curable, deep-seated cancer, any more than the surgical resident is expected to undertake the operative cure of a tumor of the brain. Some of the residents who receive their training in the department of radiology of a general hospital will become assistants in more highly specialized clinics and will develop special knowledge in such fields as the radiation treatment of cancer, the diseases of children, or in one of the anatomic divisions of specialized medicine. Experience has shown that when this route is taken to one of the subspecialties the best men are developed.

At the present time there are a considerable number of the leaders in radiology who believe that therapeutic radiology should be taught from the beginning as a separate specialty and that the standards set by the Board in this subject should be raised. In the treatment of curable cancer it is true that the average diplomate is lacking both in experience and training, but this group of cases does not constitute more than 10 per cent of the cases seen in a general radiation treatment clinic and with the advances being made in other methods of treatment for cancer it is getting smaller. Furthermore, there are very few clinics outside the large medical centers properly equipped for the treatment of these cases. The other 90 per cent can, as a rule, be taken care of in their home town by the local radiologist who has had the training at present required by the boards. If this is true, it would seem unwise to deny the men who are to do the greater part of the work in radiology the training which is necessary for them to be of the greatest service to their communities. It might be desirable to raise the standards for that rather small group who apply for certification in therapeutic radiology only, as it is this group which will locate in large medical centers and to whom the more difficult cases will be referred.

The teachers in radiology, as in any other specialty, if they are to meet the present and future needs of the public, must see to it that the community hospitals are supplied with men competent to carry on the work required of them. The large teaching and research centers will take care of themselves as they are usually in a position to influence specially selected graduates to remain as junior assistants. These latter men will become the future teachers, research workers, and masters of the highly specialized branches of radiology. It is my opinion that over-specialization during the residency period is neither necessary nor desirable.

George W. Holmes, M.D.
Belfast, Maine

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Barton R. Young, 3401 North Broad St., Philadelphia, Pa. Annual meeting: Jefferson Hotel, St. Louis, Mo., Sept. 26–29, 1950.

AMERICAN RADIUM SOCIETY
Secretary, Dr. H. F. Hare, 605 Commonwealth Ave., Boston, Mass. Annual meeting: Roosevelt Hotel, New York, N. Y., May 25–26, 1950.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y. Annual meeting: 1950, to be announced.

AMERICAN COLLEGE OF RADIOLOGY
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6. Annual meeting: 1950, to be announced.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Paul C. Hodges, 950 E. 59th St., Chicago, Ill. Annual Meeting: 1950, to be announced.

ALABAMA RADIOLOGICAL SOCIETY
Secretary, Dr. W. W. Anderson, Tuscaloosa, Ala. Meets time and place Alabama State Medical Association.

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS
Secretary, Dr. R. Lee Foster, 507 Professional Bldg., Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

ARKANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

ATLANTA RADIOLOGICAL SOCIETY
Secretary, D. W. W. Bryan, 490 Peachtree St., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, Oct. through April.

BUFFALO RADIOLOGICAL SOCIETY
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

CENTRAL OHIO RADIOLOGICAL SOCIETY
Secretary, Dr. Paul D. Meyer, Grant Hospital, Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Seneca Hotel, Columbus, Ohio.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. John H. Gilmore, 720 N. Michigan Ave., Chicago 11, Ill. Meets second Thursday of each month October to April inclusive at the University Club.

CINCINNATI RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Elsey, 927 Carew Tower, Cincinnati 2, Ohio. Meets last Monday of each month, September to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Hannan, Cleveland Clinic, Cleveland 6, Ohio. Meetings at 6:30 P.M. on fourth Monday of each month from October to April.

COLORADO RADIOLOGICAL SOCIETY
Secretary, Dr. Paul E. RePass, 306 Republic Bldg., Denver 2, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

CONNECTICUT VALLEY RADIOLOGIC SOCIETY
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday Oct. and April.

DALLAS-FORT WORTH ROENTGEN STUDY CLUB
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. W. G. Belanger, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

EAST BAY ROENTGEN SOCIETY
Secretary, Dr. Dan Tucker, 434-30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

FLORIDA RADIOLOGICAL SOCIETY
Secretary, Dr. F. K. Hurt, Riverside Hospital, Jacksonville, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

GEORGIA RADIOLOGICAL SOCIETY
Secretary, Dr. Robert Drane, DeRenne Apartments, Savannah, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

GREATER MIAMI RADIOLOGICAL SOCIETY
Secretary, Dr. David Kirsh, 712 duPont Bldg., Miami 32, Florida. Meets last Wednesday of each month at 8:00 P.M. at Veterans Administration Regional Office.

HOUSTON X-RAY CLUB
Secretary, Dr. Curtis H. Burge, 3020 San Jacinto St. Houston 4, Texas. Meets fourth Monday each month.

RADIOLOGICAL SOCIETY OF KANSAS CITY
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

IOWA X-RAY CLUB
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

KANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Anthony F. Rossitto, Wichita Hospital, Wichita, Kan. Meets annually with State Medical Society.

KENTUCKY RADIOLOGICAL SOCIETY
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

KINGS COUNTY RADIOLOGICAL SOCIETY
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

LOS ANGELES RADIOLOGICAL SOCIETY
Secretary, Dr. Wybren Hiemstra, 1414 S. Hope St., Los Angeles 15, Calif. Meets second Wednesday each month at Los Angeles County Medical Assn. Building.

LOUISIANA RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

* Secretaries of societies are requested to send timely information promptly to the Editor.

Louisville Radiological Society
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

Michigan Association of Roentgenologists
Secretary, Dr. R. D. McDuff, 220 Genesee Bank Bldg., Flint 3, Mich.

Milwaukee Roentgen Ray Society
Secretary, Dr. T. J. Pfeffer, 839 N. Marshall St., Milwaukee 2, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. Chauncey N. Borman, 802 Medical Arts Bldg., Minneapolis 2, Minn. Two meetings yearly, one at time of Minn. State Med. Assn., the other in the fall.

Nebraska Radiological Society
Secretary, Dr. Ralph C. Moore, Nebraska Methodist Hospital, Omaha 3, Nebr. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Harvard Club.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. F. H. Ghiselin, 111 East 76th St., New York 21, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 1420 E. Fifth St., Charlotte 4, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement. Annual session with State Medical Society in May, 1950, at Grand Forks, N.D.

Northern California Radiological Club
Secretary, Dr. R. L. Ayers, 726 4th St., Marysville, Calif. Meets at dinner last Monday, every second month, except June, July and August.

Ohio State Radiological Society
Secretary, Dr. E. C. Elsey, 927 Carew Tower, Cincinnati 2, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. W. E. Brown, Tulsa, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. Selma Hyman, Univ. of Oregon Medical School, Portland, Oregon. Meets monthly 2nd Wednesday, 8:00 P.M.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport. Annual Meeting: May 20 and 21, 1949, Bedford Springs Hotel, Bedford, Pa.

Philadelphia Roentgen Ray Society
Secretary, Dr. G. P. Keefer, 1930 Chestnut St. Meets first Thursday each month October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary Dr. E. J. Euphrat, 3500 Fifth Ave., Pittsburgh 13, Pa. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Queens Roentgen Ray Society
Secretary, Dr. J. E. Goldstein, 88-29 163rd St., Jamaica 3, N. Y. Meets fourth Monday of each month except during the summer.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Harry A. Miller, 2452 Eutaw Place, Baltimore. Meets third Tuesday each month, Sept. to May.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Fred Zaff, 135 Whitney Ave., New Haven, Conn. Meets bimonthly on second Wednesday.

Radiological Section, District of Columbia Medical Society
Secretary, Dr. K. C. Corley, 1835 Eye St., N. W., Washington, D. C. Meets Medical Society Auditorium, third Thursday, Jan., March, May, Oct. at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Radiological Society of New Jersey
Secretary, Dr. Benjamin Copleman, 280 Hobart St., Perth Amboy, N. J. Meets annually at Atlantic City at time of State Medical Society and mid-winter at Elizabeth, N. J.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Ralph E. Alexander, 101 Medical Arts Bldg. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. Maurice D. Frazer, 1037 Stuart Bldg., Lincoln, Nebr. Meets Shirley-Savoy Hotel, Denver, Colo. August 18, 19, 20, 1949.

St. Louis Society of Radiologists
Secretary, Dr. C. J. Nolan, 737 University Club Bldg., St. Louis 3, Mo. Meets fourth Wednesday each month, except June, July, August, and September.

San Diego Roentgen Society
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly, first Wednesday at dinner.

Section on Radiology, California Medical Association
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. Harold L. Shinall, St. Joseph's Hospital, Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston first Thursday in November, also with South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas. Next meeting, Dallas, Texas, February 3 and 4, 1950.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May inclusive. Room 203, Service Memorial Institute, 426 N. Charter St., Madison.

UTAH STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

VIRGINIA RADIOLOGICAL SOCIETY
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

WASHINGTON STATE RADIOLOGICAL SOCIETY
Secretary, Dr. J. H. Walker, 1115 Terry Ave., Seattle 1, Wash. Meets fourth Monday each month, October through May, College Club, Seattle.

WISCONSIN RADIOLOGICAL SOCIETY
Secretary, Dr. Irving I. Cowan, 425 E. Wisconsin Ave., Milwaukee 2, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-RAY STUDY CLUB OF SAN FRANCISCO
Secretary, Dr. W. F. Reynolds, University of California Hospital, San Francisco. Meets from January to July, 1949, at Lane Hall, Stanford University Hospital, and from July to December 1949, at San Francisco Hospital.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGIA Y FISIOTERAPIA
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 P.M.
Medical Members' meeting, on third Friday in each month at 5:00 P.M., 32 Welbeck St., London, W 1.

FACULTY OF RADIOLOGISTS
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Honorary Secretary, Dr. E. M. Crawford, 1535 Sherbrooke St., West, Montreal 26, Que. Meetings January and June.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

AUSTRALIAN AND NEW ZEALAND ASSOCIATION OF RADIOLOGISTS
Honorary Secretary, Dr. Alan R. Colwell, 135 Macquarie St., Sydney, N.S.W.
Honorary Secretaries, State Branches:
New South Wales, Dr. E. W. Frecker, 135 Macquarie St., Sydney.
Victoria, Dr. T. I. Tyrer, 3 Lockerbie Court, East St. Kilda.
Queensland, Dr. J. Adam, 131 Wickham Terrace, Brisbane.
South Australia, Dr. R. de G. Burnard, 170 North Terrace, Adelaide.
Western Australia, Dr. A. M. Nelson, 179-B St. Georges Terrace, Perth.
New Zealand, Dr. E. G. Lynch, 12 Bolton St., Wellington.

SOUTH AMERICA

SOCIEDAD ARGENTINA DE RADIOLOGIA
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

SOCIEDAD ARGENTINA DE RADIOLOGÍA, FILIAL DEL LITORAL
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 7:00 P.M., 663 Italia St., Rosario.

SOCIEDADE BRASILEIRA DE RADIOLOGIA MEDICA
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

SOCIEDADE BRASILEIRA DE RADIOTERAPIA
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

SOCIEDAD PERUANA DE RADIOLOGIA
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

SOCIEDAD DE RADIOLOGICA, CANCEROLOGIA Y FISICA MEDICA DEL URUGUAY
Secretary, Dr. Arias Bellini.

CONTINENTAL EUROPE

SOCIÉTÉ BELGE DE RADIOLOGIE
General Secretary, Dr. S. Masy, 111 Avenue des Alliés, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

CESKOSLOVENSKÁ SPOLEČNOST PRO RÖNTGENOLOGII A RADIOLOGII V PRAZE
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

GDANSK SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10.30, X-Ray Dept., Akademia Gdansk.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Meets monthly.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD. USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT (SOCIÉTÉ SUISSE DE RADIOLOGIE)
President, Dr. H. E. Walther, Gloriastr. 14, Zürich, Switzerland.

SOCIETA ITALIANA DI RADIOLOGIA MEDICA
Secretary, Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

CONFERENCE OF TEACHERS OF CLINICAL RADIOLOGY

The Seventeenth Annual Conference of Teachers of Clinical Radiology, sponsored by the Commission on Education of the American College of Radiology, will be held at the Drake Hotel, Chicago, Illinois, on Saturday, February 4, 1950. All those interested in radiological teaching are invited to attend. Director Arthur W. Erskine, President of the American College of Radiology, will preside at the noon luncheon.

Morning Session—9:30 A.M.–12:00 M.

Chairman, Dr. B. R. Kirklin, Secretary of the American Board of Radiology

Discussion: "Graduate Training in Radiology as Revealed by the Recent Inspection Program."

Conditions encountered during the inspection of hospitals will be presented by various inspectors and certain members of the American Board of Radiology. Recommendations for future training standards will be discussed.

Luncheon

Address by Arthur W. Erskine, M.D., President, American College of Radiology

Afternoon Session—2:00 P.M.–4:30 P.M.

Chairman, Dr. John D. Camp, Secretary, Commission on Education.

1. "Graduate Training in Radiology for Residents in Other Specialties."

Discussion of the radiologist's responsibility for such training, policies, methods of instruction, requirements for other Board examinations, and the desirability of establishing a uniform policy concerning same.

2. "Supplementary Methods of Training in Radiation Physics."
   A. Correspondence course.
   B. Short, intensive course to be given in various central locations.

There have been requests for courses of the above type to supplement the training in radiation physics that is available in smaller institutions. The Commission hopes that this discussion will determine whether or not such supplementary training is deemed necessary and, if so, how it should be organized.

3. "Publication of a Recommended Reading List of Radiologic Literature for Residents."

Requests for such a list have been received. How should such a list be prepared and how extensive should it be?

MID-WINTER RADIOLOGICAL CONFERENCE

The Second Annual Mid-Winter Radiological Conference sponsored by the Los Angeles Radiological Society will be held at the Biltmore Hotel on February 25 and 26, 1950. Non-radiological colleagues interested in any of the courses are, of course, invited to attend. The cost for the entire two day session is $15.00. A banquet will be held on Saturday evening, February 25, at which Dr. Juan A. del Regato will deliver an address on "Transvaginal Roentgen Therapy for Carcinoma of the Cervix." The charge for the banquet is $5.00. Reservations for the meetings and banquet should be accompanied by a check for $20.00 and sent to Dr. Moris Horwitz, 441 North Camden Drive, Beverly Hills, California. Hotel reservations may be made by applying directly to the convention manager of the Biltmore Hotel, Los Angeles, California. Early reservations are suggested since accommodations are limited.

The program is as follows;

Saturday, February 25, 1950

10:15 A.M. Dr. William Costolow, President of Los Angeles County Medical Association. Address of Welcome.

10:30 A.M. Dr. George Griffith, Pasadena, California. The Roentgen Treatment of Hypertension.

11:00 A.M. Dr. Robert Pugh, Pasadena, California. Pitfalls of Radiation Protection.

11:30 A.M. Dr. Ray A Carter, Los Angeles, California. Roentgen of Manifestations of Certain Granulomatous Lesions of the Lungs.

2:00 P.M. Dr. Gordon G. King. San Francisco, California. Similar Anom-

alies and Dystrophies in Infants and Young Children.

2:45 P.M. Dr. Marcy L. Sussman, Phoenix, Arizona. Newer Diagnostic Methods in Difficult Congenital Cardiac Cases.

3:30 P.M. Dr. Samuel Perzik, Beverly Hills, California. Surgical Management of Post-irradiation Complications of the Larynx.

4:15 P.M. Dr. Ian MacDonald, Los Angeles, California. The Use and Abuse of Hormone Therapy in the Treatment of Cancer.

6:00 P.M. Cocktails. (Compliments of the X-Ray and Radium Equipment Manufacturers and Suppliers of Los Angeles)

7:00 P.M. Banquet: Master of Ceremonies: Dr. Lowell Goin. Speaker: Dr. Juan A. del Regato. Transvaginal Roentgen Therapy for Carcinoma of the Cervix.

Sunday, February 26, 1950

9:30 A.M. Dr. Marcy L. Sussman, Phoenix, Arizona. Granulomatous Diseases of the Small Bowel.

10:15 A.M. Dr. Henry Kaplan, San Francisco, California. Roentgen Examination of the Colon.

11:00 A.M. Dr. Earl R. Miller, San Francisco, California. Radioactive Iodine in Medicine.

2:00 P.M. Dr. Juan A. del Regato, Colorado Springs, Colorado. Roentgen Therapy of Carcinoma of the Lip.

3:00 P.M. Dr. Henry C. Crozier, Los Angeles, California. Myelography: A Review of 453 Consecutive Cases.

APPOINTMENTS TO STAFF OF CLEVELAND CLINIC FOUNDATION

Dr. Robert A. Hays has been appointed a member of the staff in the Department of Therapeutic Radiology. Dr. Hays graduated from Boston College in 1936 and from Tufts College Medical School in 1940. Following the completion of his internship at Worcester City Hospital, Worcester, Massachusetts, in 1942, Dr. Hays spent three years in the U.S. Army. He was granted a fellowship at the Cleveland Clinic in 1945 and was appointed to the assistant staff in 1949. Dr. Hays was certified by the American Board of Radiology in 1949.

Dr. Robert E. Wise has been appointed a member of the staff in the Department of Roentgenology. Dr. Wise attended the University of Pittsburgh and graduated from the University of Maryland School of Medicine in 1943. He served with the U.S. Navy for four years, receiving his internship at the U.S. Naval Hospital in Philadelphia. In 1947 Dr. Wise was granted a two year fellowship at the Cleveland Clinic and was made a staff assistant in 1949. He has been certified by the American Board of Radiology.

NEWSPAPER PUBLICITY ON THE BETATRON

The recent newspaper publicity on the medical betatron at the University of Illinois College of Medicine is totally unauthorized and grossly exaggerated. *Time* magazine of December 19, has, in spite of warning, distorted facts to the point of absurdity.

I am neither optimistic nor enthusiastic about the ability of the betatron to solve the cancer problem. In its present state it may be helpful in about 10 per cent of cancer patients. It is not suitable for widespread cancer, for patients in the terminal stages of cancer, or in cancers of a radioresistant type.

Physicians having patients afflicted with cancer are urged to institute prompt and adequate treatment in their own communities by accepted methods. We can treat so few patients a month on the betatron that the local tumor clinics send us all the cases that we can possibly treat at the present time.

ROGER A. HARVEY, M.D.
Professor of Radiology and Chairman of the Department
University of Illinois,
College of Medicine
Chicago, Illinois

GEORGE EASTMAN HOUSE

George Eastman House was opened to the public on November 9, 1949, in Rochester, New York. The opening included ceremonies held in the Eastman Theater and at George Eastman House. Distinguished visitors from the world of photography and related arts and sciences attended. Collections of historical photographic equipment and materials are displayed in specially designed cases in the main house. Space for the contemporary exhibits of photography in science and industry is available in a building at the rear of the house.

The house itself is a magnificent Georgian Colonial home at 900 East Avenue, Rochester, New York. Eastman, the famed photographic pioneer, built it for himself and his mother in 1905. He bequeathed it to the University of Rochester at the time of his death in 1932 as a home for the University's president. The house was set up as an independent photographic educational institute approved by the New York State Board of Regents in June, 1947. Officially known as George Eastman House, Inc., it is expected to become a world center for the demonstration of photography as an art and science.

RADIOLOGICAL HEALTH BRANCH ESTABLISHED

Formation of a new unit under the Public Health Service, Federal Security Agency, to develop a radiological health program to meet potential health hazards created by increased use of radioactive materials and radiation-producing apparatus has been announced. Established within the recently formed Engineering Resources Division of the Public Health Service, the new unit is known as the Radiological Health Branch and is under the direction of Dr. Edwin G. Williams, a Public Health Service medical director.

The Radiological Health Branch will correlate radiological health activities in the Public Health Service, develop a training program in radiological health for Service officers and other public health workers, and act as a source of information on radiological health for other units of the Service, for other Federal agencies, and for State and local health agencies.

NORTH DAKOTA RADIOLOGICAL SOCIETY

At a recent meeting of the North Dakota Radiological Society the following officers were elected for 1950: *President:* Dr. Philip H. Woutat, Grand Forks, North Dakota; *Vice-President*, Dr. H. M. Berg, Bismarck, North Dakota; *Secretary-Treasurer*, Dr. Charles Heilman, Fargo, North Dakota. A meeting will be held in Fargo, North Dakota, in January, 1950, and the annual session with the State Medical Society in May, 1950, at Grand Forks, North Dakota.

AMERICAN RADIUM SOCIETY

The American Radium Society will not meet at the Hotel Biltmore as previously arranged but instead will meet at the Roosevelt Hotel, Madison Avenue at 45th Street, New York, May 25 and 26, 1950.

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. LEUCUTIA, M.D., Harper Hospital, Detroit 1, Michigan

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ROENTGEN DIAGNOSIS

NECK AND CHEST

Tedeschi, C. G. Mammary lipoma. *Arch. Path.*, Oct., 1948, *46*, 386–397.

Clinically lipomas of the breast are important chiefly in differential diagnosis, and the author stresses that, as in the case of the other fatty disturbances (fat necrosis and xanthomata), the distinction between these and more serious tumors of the breast is best made by the pathologist. Nevertheless, the lipomas have a more or less characteristic clinical appearance and history.

Tedeschi presents 11 cases of lipoma (2 multiple) and 1 case of liposarcoma found in a series of 274 consecutive operative cases of mammary tumor, an incidence of 4.6 per cent which is about the average of previous reports. Eleven of the 12 tumors were in females. Ages ranged from twenty-five to seventy-five. None was attached to the skin, nipple, or deeper structures. There was a history of trauma in only 2 cases. Ten of the lipomas were tender. Most of the tumors grew very slowly. Only 1 recurred postoperatively and it was rather poorly demarcated. Grossly 8 of the tumors were encapsulated. They were usually soft, yellow and interlaced with fibrous strands. The microscopic picture was most variable, and the author discusses histopathological classification at length. —*David D. Beiler, M.D.*

Saltzstein, Harry C., and Pollick, Robert S. Localization and treatment of papillomas of the breast. *Cancer*, Nov., 1948, *1*, 625–633.

The authors mention four types of bleeding from the nipple, the last of which is discussed with presentation of 8 cases.

1. Bleeding with a large, hard, palpable mass clinically resembling cancer.
2. Bleeding associated with a mass that is more characteristic of chronic mastitis.
3. Bleeding associated with a small palpable tumor, usually in the periphery of the

alveolar region and easily localized by palpation.

4. Bleeding in the absence of a palpable tumor.

In the latter group, the breast is frequently removed, but the authors favor using mammography for localization of the papilloma, followed by local excision of the involved duct with the contained papilloma.

The study by Foote and Stewart showed that only a minute fraction of the total number of intraductal papillomas become cancerous.

The technique of mammography is well described.—*M. M. Manalan, M.D.*

FARINAS, P. L. Bronchography by atomization. *Radiology*, Oct., 1948, *51*, 491–498.

The author performs bronchography by atomizing 20 per cent lipiodol. The base of the tongue, the larynx and trachea are anesthetized by using 1 per cent pontocaine, with the patient sitting up.

The atomization lasts about two minutes. The patient is immediately placed in the horizontal position and roentgenograms made according to the side and pulmonary segments to be explored.

Very fine details of the bronchial mucosa may be observed. There is no considerable accumulation of lipiodol since the amount used is small, and the atomized medium is rapidly eliminated. When there is bronchial obstruction the opaque medium accumulates above the obstruction. When there is no obstruction the opaque medium reaches as far down as the alveoli, coating the internal surface of the bronchi.—*Benjamin Copleman, M.D.*

DOUB, HOWARD P. Miliary calcification of the lungs; etiologic aspects. *Radiology*, Oct., 1948, *51*, 480–490.

Some cases of miliary calcifications are due to a tuberculous infection, such as a hematogenous (non-miliary) spread, or even to a miliary spread. Evidence has been presented by some workers, on the basis of skin tests, that histoplasmosis may be responsible for many cases of pulmonary calcifications.

Five cases, a mother and 4 children, in whom the tuberculin reactions were negative, but the skin tests and sputum cultures were positive for aspergillosis and moniliasis, were followed for several years. In the beginning, the lesions were widely disseminated, larger and less circumscribed than is usual in miliary tuberculosis. Later, they became larger, then smaller, more discrete and dense. After about two years, small flecks of calcification appeared in the nodules. In the tenth year the calcified lesions are dense and smooth.

It is believed, therefore, that in addition to tuberculosis, and histoplasmosis, such mycoses as aspergillosis and moniliasis may also produce miliary pulmonary calcifications.—*Benjamin Copleman, M.D.*

KING, DONALD S. Pulmonary fibrosis; clinical aspects. *Radiology*, Oct., 1948, *51*, 477–479.

From the clinical standpoint, there are four groups of cases in which pulmonary fibrosis plays an important role:

The group with "senile emphysema" is probably the largest and most important. Acute respiratory infection is often the apparent inciting factor. The fibrosis is the result of an organizing pneumonia. Cor pulmonale plays a definite part in these cases, and the severity of the symptoms is independent of the degree of fibrosis. Many cases of asthma fall in this group.

There is a group of granulomatous fibrosis resembling sarcoid disease histopathologically but not clinically. The age of onset is in or near the thirties. Death occurred in each case. The exact etiology is unknown at present.

There is a large group of cases due to such specific causes as tuberculosis, silicosis, and radiation therapy.

There are other miscellaneous causes, such as bronchiolectasis, where there is marked dilatation of the smaller bronchioles, with very little dilatation or infection of the larger bronchi.—*Benjamin Copleman, M.D.*

ROBBINS, LAURENCE L. Idiopathic pulmonary fibrosis; roentgenologic findings. *Radiology*, Oct., 1948, *51*, 459–467.

The diagnosis of pulmonary fibrosis can only be made after correlating the roentgen and clinical findings with the known pathology of similar cases.

The early appearance is that of a slight prominence of the pulmonary markings. Later there is a tendency to nodularity. Diaphragmatic motion may be impaired, and areas of emphysema become apparent. In advanced cases there are heavy strand-like shadows interspersed with areas of emphysema. At this stage there is marked limitation of diaphragmatic movement, especially on expiration. There may be widen-

ing of the trachea. In some cases the emphysema is out of proportion to the fibrosis. Cor pulmonale is present far oftener than is apparent from the roentgen evidence alone.

In the differential diagnosis, radiation fibrosis is usually localized to the areas of treatment. Asthma shows no characteristic findings, and cannot be differentiated from the idiopathic cases. Silicosis also cannot be differentiated, until coalescence occurs, when there is usually more emphysema at the apices than in the idiopathic form. In sarcoid and erythema nodosum, there is, as a rule, symmetrical enlargement of the hilar and mediastinal lymph nodes. In beryllium exposure the appearance is much like sarcoid, except that the patients tend to have many more symptoms. In lymphangitic carcinosis the shadows extend to the lung periphery, becoming slightly wider at the pleural margin, and hilar node enlargement is often evident.

Enlargement of pulmonary blood vessels and lymphatics may have the same roentgenologic appearance as pulmonary fibrosis, since anatomically these structures, as well as the bronchi, are located where fibrosis may first appear. —*Benjamin Copleman, M.D.*

Hobby, W. A. Pulmonary mycoses. *Dis. of chest*, Feb., 1949, *15*, 174–185.

The author summarizes the common pulmonary mycoses with clinical, pathological, therapeutic, and roentgenographic differences, with emphasis on the careful evaluation of diagnostic laboratory methods to differentiate them from tuberculosis.

Actinomycosis is a disease sometimes caused by aerobic fungi without "sulphur granule" formation, but more commonly by the anaerobic variety producing the granules. This latter type has been a cause of so-called "farmer's lung" in Britain. Farmers exposed continuously to mouldy hay dust develop a productive cough and show evidence of fibrosis, emphysema, and possibly bronchiectasis on the roentgenograms.

Coccidioides immitis causes San Joaquin Valley fever, the clinical and pathological description of which is carefully outlined. The roentgenograms may show nodular foci, cyst-like cavities, persistent pneumonitis, adenopathy, or miliary spread.

Blastomycosis shows nonspecific dense parenchymal masses with irregular outline in the films. Sporotrichosis and conisporiosis are mentioned as pathogenic fungi.

Moniliasis shows minimal bronchial fibrosis on the chest roentgenograms, except in "thrasher's lung" with typical miliary distribution of fine mottling.

Primary pulmonary aspergillosis may show only nodular diffuse shadows or dense lesions, with cavitation. The signs, symptoms and clinical course parallel tuberculosis.

Torulosis infections tend to invade the central nervous system, but primary pulmonary disease shows dense infiltration similar to tuberculosis or neoplasm without cavitation.

Finally, histoplasmosis is a disease of several manifestations: the disseminated stage is fatal, while a benign form may be responsible for pulmonary calcification observed in patients with negative reaction to tuberculin.—*Frederick Gilmore, M.D.*

Robbins, Edward, and Silverman, Gertrude. Coexistent bronchogenic carcinoma and active pulmonary tuberculosis. *Cancer*, Jan., 1949, *2*, 65–97.

The incidence of cancer of the lung in cases of tuberculosis is about 1.5 per cent. This percentage has been established in a total of 2,900 autopsied tuberculous cases.

Although various theories have been propounded as to the relationship between these disease entities, Cooper feels that the association of pulmonary cancer with tuberculosis should be regarded as coincidental until more is known about the cause of malignancy. The apparent increase in the number of cases of coexistent pulmonary cancer and tuberculosis is due to the fact that patients with tuberculosis are living longer.

The authors present 11 cases of primary bronchogenic carcinoma and 1 case of bronchial adenoma, all associated with coexistent active pulmonary tuberculosis. The clinical and postmortem findings in these cases are discussed and the following conclusions summarized:

Patients with pulmonary tuberculosis complaining of severe or prolonged chest pain should be suspected of having coexistent carcinoma of the lung.

Cases with cancer of the lung should not be excluded as non-tuberculous on the basis of one negative sputum. Multiple sputum examinations are needed to rule out this possibility, especially where bilateral pulmonary infiltrations are present.

Radiation therapy directed to a pulmonary

neoplasm entails a definite risk of activation of coexisting pulmonary tuberculosis.

The presence of an obstructing bronchial lesion may be a definite factor in accentuating the severity of tuberculosis in the lung parenchyma distal to the obstruction.

A definite causal relationship between pulmonary tuberculosis and bronchogenic carcinoma is not established.—*W. C. Gallo, M.D.*

Thoyer-Rozat, P., and Piequet, J. L'angiocardiographie. Son intérêt clinique et radiologique. (Angiocardiography; its clinical and roentgenological interest.) *J. de radiol. et d'électrol.*, Jan.–Feb., 1949, *30*, 3–11.

These workers at the Hôpital Pitié, Paris, use a modified Robb and Steinberg angiocardiographic apparatus. The rapid exposures are made with the patient in decubitus position, the magazine holding unexposed cassettes feeds them along a track over which they roll into position at the exposure panel and thence into a lead-lined receiving chamber. The authors discuss their technique of preparation of the patient: sedation, sensitivity tests with diodrast, and determination of circulation time (ether-time for the pulmonary circulation and either saccharin or cyanide-time for the left heart and aorta). They use a Siemen's rotating anode machine, 75–80 kv. (peak), 300 ma., 1/10 second, anode-film distance of 1 m. 20, and no grid. The authors have constructed a device similar to the one described except that the exposures will be made with the patient sitting and at rate of eight films in seven seconds. This article contains many fine reproductions of angiocardiograms of the usual types of lesions for which this method is so essential.—*William M. Loehr, M.D.*

Hughes, Wilson E. Esophagopleural fistula following perforation of esophagus by foreign body. *Am. J. Dis. Child.*, Oct., 1948, *76*, 401–410.

A case of esophagopleural fistula following perforation by a foreign body, a safety-pin, with subsequent recovery is reported. Such a fistula following esophageal perforation is rare. Three cases have been reported previously in 2 of which the diagnosis was first entertained because of the presence of food particles in the pleural cavity, while in the third case, the condition was not discovered until autopsy. The diagnosis in Hughes' case was established both by the presence of food particles in the pleural cavity and by fluoroscopic visualization of iodized oil passing through the fistula from the esophagus into the pleural cavity.

On the first roentgen examination the safety-pin was shown in a lateral view of the chest lying in the upper thoracic portion of the esophagus with the pin open and directed upward. With the patient erect a hydropneumothorax, right side, was demonstrated on the third day after admission. Roentgenograms made eighty-four hours after admission to the hospital showed spurts of iodized oil entering the upper right portion of the chest from the esophagus.

Healing of the fistula did not occur until oral feeding and tube feeding were stopped and the child maintained on parenteral alimentation.—*R. S. Bromer, M.D.*

ABDOMEN

Spellberg, M. A., and Zivin, Simon. Lymphosarcoma of the gastrointestinal tract. *Arch. Int. Med.*, Feb., 1949, *83*, 135–149.

Eleven cases of primary gastric lymphosarcoma are reported. Eighty-eight cases of gastric carcinoma were observed for each case of gastric lymphosarcoma. Roentgenologic examination usually fails to establish a diagnosis; gastroscopy may be of help. The prognosis of the small cell type of lymphosarcoma is better than that of the reticulum cell type. Resection followed by irradiation is the treatment of choice. The prognosis of gastric lymphosarcoma appears to be better than that of gastric carcinoma. Ten cases of primary intestinal lymphosarcoma are reported. Three hundred colonic carcinomas were seen for each lymphosarcoma, which shows that this neoplasm is extremely rare in the colon. Intestinal lymphosarcoma appears to carry an extremely poor prognosis; no patient survived five years, and most died in less than six months.—*Eugene J. McDonald, M.D.*

Wyatt, J. P., and Khov, P. N. Ulcers of the upper part of the gastro-intestinal tract associated with acute damage of the brain. *Arch. Path.*, Feb., 1949, *47*, 110–118.

This paper is a presentation of the only 4 cases of upper gastrointestinal ulceration in a series of 210 acute fatal head injuries and cerebral vascular accidents.

These patients ranged in age from twelve to seventy-four. All 4 were unconscious from admission and took nothing by mouth during the one and one-half to five days before their

deaths. The authors suggest that patients living less than twenty-four hours do not have time to develop gastrointestinal ulcerations. All gave evidence of gross bleeding before death. Three of the 4 had extensive lesions in the hypothalamus as well as damage elsewhere in the brain.

All had multiple "hemorrhagic mucosal erosions" and multiple ulcerations which were definitely ante mortem. Three had gastric ulcers; of these 2 had esophageal perforations and 1 had multiple gastric perforations and a duodenal ulcer. The fourth had only two shallow duodenal ulcers without perforation.

The authors discuss the controversial question of the mechanism by which these ulcers are produced without arriving at any definite conclusion.—*David D. Beiler, M.D.*

Jenkinson, E. L., and Hamernik, F. J. Roentgenologic deformities of the pyloric portion of the stomach with absence of surgical and pathological findings. *Radiology*, Dec., 1948, *51*, 798–805.

Seven cases are reported in which a diagnosis of malignant changes of the pylorus was made but in which surgery or autopsy failed to reveal any neoplasm. In each case there are reproductions of films purporting to demonstrate a lesion. None of these seem to be pressure studies. Possibly these false positive conclusions could be avoided by study of the mucosa of the suspected region on successive days, if necessary, until a definite decision as to the integrity or destruction of the mucosa is reached.

The authors feel, however, that although it is embarrassing to have negative operative findings, nevertheless exploration is a relatively harmless procedure and warranted by the risk of missing an operable malignant neoplasm.

An attempt is made to explain these pseudo filling defects on an anatomical basis accompanied by a recitation of the embryologic development, the arterial, venous and lymphatic supply, as well as the nerve supply of the upper gastrointestinal tract.—*Frank Huber, M.D.*

Russell, Walter A., Weintraub, Sydney, and Temple, Harold L. An analysis of X-ray findings in 405 cases of benign gastric and pyloric ulcer. *Radiology*, Dec., 1948, *51*, 790–797.

The authors have analyzed 429 gastric and peptic ulcers in 405 patients hospitalized during the past fifteen years for the purpose of (1) determining the most frequent sites of benign gastric ulcers and (2) to discover the reasons for the difference in location as reported by the radiologist, surgeon, and the pathologist.

Most of the discrepancies between the radiologist, surgeon, and pathologist occurred in the pyloric region. Under anesthesia the pylorus is usually relaxed and not thoroughly demonstrated. Frequently the pathologist has an inadequate specimen.

There is considerable confusion in the anatomic terminology of the stomach. The proposed anatomic terminology of the authors and the distribution of the ulcers is well illustrated by the drawings.

Two hundred and seventy-eight ulcers, or 64.8 per cent, were located in the pars media and incisura angularis (body), mostly along the posterior wall of the lesser curvature; 81, or 18.9 per cent, occurred at the pylorus. The following criteria are used for the diagnosis of pyloric ulcer: (a) lengthening of the pyloric sphincter (wide interval); (b) distortion of the pyloric sphincter (crooked stem); (c) a niche, usually small, located within the pyloric canal. Thirty-five, or 8.2 per cent, were prepyloric ulcers and 32, or 7.5 per cent, were in the antrum proximal to the prepylorus. Two cases occurred in the fundus. There were multiple ulcers present in 23, or 5.7 per cent.

Eight tables give the results of the statistical analysis.

The results of medical and surgical treatment are presented. In 193 cases treated medically good results were obtained in 40.8 per cent. The figures are based upon 142 cases followed for one year or longer. Of 183 gastric resections in which 151 were followed for at least a year, 92.1 per cent had good results. In 60 surgical cases, excluding gastric resections, of which 56 were followed for a year, 62.5 per cent obtained good results. The ratio of males to females was approximately 3 to 1.—*Norman Heilbrun, M.D.*

Furey, Warren W. X-ray observations before and after vagotomy. *Radiology*, Dec., 1948, *51*, 806–815.

This article is to be considered as a preliminary report on a controversial method of treatment of peptic ulcer.

The author bases his paper on the study of 40 patients, of whom 25 were vagotomized by the same surgeon. Transthoracic vagotomy was performed in 10 instances and transabdominal in 30. It is important to note that 8 gastroen-

terostomies and 2 gastric resections were done at the time of the vagus resection. Preoperative statistics of the group are summarized. Vagus resections, for the most part, were done for chronic or recurrent ulcer.

Symptomatically results have been favorable, only 3 being failures. Eighteen months is the longest postoperative interval. Postoperative complaints have been of minor character and transient. It has been suggested by one of the discussants that relief of pain may be primarily due to severance of afferent nerve fibres.

Objectively, however, occasionally startling and paradoxical roentgen findings have been encountered in this series such as marked gastric retention or persistence of evidence of ulcer either in the duodenum or stomach.

Twelve case histories, some of them with illustrative film reproductions, are presented. Most of these had postoperative gastric retention.—*Frank Huber, M.D.*

ARIEL, IRVING M. The nature of postoperative hypoproteinemia in patients with gastrointestinal cancer. *Surg., Gynec. & Obst.*, Feb., 1949, *88*, 185–195.

The data herein presented demonstrate that patients with gastrointestinal cancer suffer from a significant degree of hypoproteinemia on admission to the hospital. The hypoproteinemia is not exclusively the result of dietary deficiency, excessive bleeding, or excessive catabolism, but appears to be the result of a defect in protein synthesis.

One of these abnormalities consisted in the inability of the patients with gastrointestinal cancer properly to absorb, assimilate, and metabolize the amino acid glycine.

Following resection of the cancer, the fact that the serum protein levels returned to normal suggests that the presence of the cancer acts as an insulting agent inhibiting normal plasma protein regeneration.

The fact that the postoperative course in patients with gastrointestinal cancer is associated with a pronounced drop in plasma protein concentration and various clinical complications resulting from this hypoproteinemia focuses attention on the need for prolonged and careful preoperative regimens to maintain normal nitrogen equilibrium.

The chemical analyses of the liver revealed that the liver is not a storehouse for significant quantities of albumin and that there is marked fluctuation in the protein content of the liver in the course of an intra-abdominal operation.

During the first five postoperative days the urinary nitrogen in patients with gastrointestinal cancer averages the same as in patients with gynecological disorders and those with benign gastrointestinal tract disease, but in the latter two groups of patients the postoperative course is not frequently associated with a significant incidence or degree of hypoproteinemia.

These data suggest that patients with gastrointestinal cancer may suffer from a deprivation of the tissue protein, hence are not able to compensate for the nitrogen debt which develops during the postoperative course.—*Mary Frances Vastine, M.D.*

HENRY, F. C. Acute diverticulitis of the cecum. *Ann Surg.*, Jan., 1949, *129*, 109–118.

In reporting 3 cases of acute diverticulitis of the cecum, diagnosed preoperatively as acute appendicitis, the author states that this is not a rare disease entity. It should be included in the differential diagnosis of all patients with right lower quadrant pain. The incidence of diverticulosis of the colon is reported to range between 5 to 7 per cent. Surprisingly enough the diverticula of the cecum are often solitary and not associated with diverticula elsewhere along the colon. Although these diverticula are undoubtedly congenital, the average age of onset of symptoms, as gleaned from various authors, is approximately forty years.

In the differential diagnosis of acute diverticulitis of the cecum a barium enema may not be helpful in delineating the diverticula as they are often plugged with feces or pus or closed off by spasm. However, the roentgen examination is valuable in outlining the extent of the surgical resection necessary, for usually the differentiation between benign and malignant disease can be made. The author emphasizes the use of the minimal operative procedure and is generally against conservative measures without resection of the lesion present.—*T. D. Allison, M.D.*

WANGLE, J. M., and KIRKLIN, J. W. The importance of the level of the lesion in the prognosis and treatment of carcinoma of the rectum and low sigmoid colon. *Ann. Surg.*, Jan., 1949, *129*, 22–23.

In this excellent paper the authors discuss the problem of the prognosis of resected adenocarcinomas of the rectum and sigmoid colon as

related to the level of the lesions. For this study they use 388 cases with five year follow-ups which have been carefully tabulated as to grade, extent, and distance of the lesion from the anal margin as noted by proctoscopic examination. All of these patients had combined abdominoperineal resections.

Dividing the cases into three groups, i.e. (1) lesions within 5 cm. of the anal margin, (2) those with lesions lying 6 to 10 cm. removed from the anal margin, and (3) those with lesions 11 cm. or more removed from this point, the writers demonstrate clearly that the first group, the very low lying rectal carcinomas, have the poorest prognosis. The authors conclude from the autopsies of their cases that this difference in prognosis is not directly related to the grade of malignancy, extent of invasion using Duke's classification, or location beneath the peritoneal reflection but rather to the failure of the combined abdominoperineal resection to cope with lateral metastatic spread of the lesion along the lymphatic pathways accompanying the middle hemorrhoidal vessels along the levator air muscles. They emphasize this is not an abnormal pathway and can occur when the superior channels are not blocked. From this study the authors favor anterior resection and primary anastomosis over abdominoperineal resection for lesions which are 11 cm. or more from the anal margin.—*T. D. Allison, M.D.*

Bodian, Martin, Stephens, F. D., and Ward, B. C. H. Hirschsprung's disease and idiopathic megacolon. *Lancet*, Jan., 1, 1949, *1*, 6–11.

The authors have separated Hirschsprung's disease from the idiopathic group and have shown its etiology by microscopic section. They have proved their ideas on clinical results of up to three months' duration.

The 73 cases reported were divided into the following classifications: (a) terminal reservoir type idiopathic megacolon (10); (*b*) tubular dilatation type idiopathic megacolon (12); (*c*) Hirschsprung's disease (39); (*d*) roentgenographically negative cases (12).

Terminal reservoir type idiopathic megacolon is described as showing a pear-shaped unilocular dilated chamber often extending from the rectum to the xiphisternum. The boundary between normal and abnormal colon is fairly well defined. In tubular dilatation the rectum appears large and the pelvic colon, which is larger and wider than usual, lacks haustration. The boundary between normal and abnormal is ill defined.

Hirschsprung's disease on roentgenography showed a narrowed segment distal to the dilated segment. At the time of fluoroscopy the barium enema is seen to fill the rectum which appears to be of normal or less than normal size. Above the rectum the diameter of the intestine narrows for a distance varying from 1–12 inches. Above this it opens by a wide funnel into a hugely dilated and gas-filled colon. Once the dilated portion is filled, the narrowing below may be obscured and difficult to demonstrate.

On microscopic section in the 15 specimens available, this narrowed distal segment revealed no parasympathetic ganglion cells in the intramural plexuses. The cause of this is not known. The authors say the histopathology is compatible with the assumption of an agenesis of ganglion cells. They conclude that this suggests a uniform pathology in Hirschsprung's disease; namely, the lack of coordinated propulsive movements and the spasm caused by unopposed sympathetic activity in the distal segment. They stress the roentgenographic differentiation of Hirschsprung's disease since they can successfully treat this condition with a rectosigmoidectomy of the narrowed segment.—*J. S. Summers, M.D.*

Umiker, W. U. Fatal viral hepatitis complicated by phlegmonous cecitis and ileocoecal intussusception. *Arch. Path.*, Nov., 1948, *46*, 493–497.

This is an unusual but instructive case report of cecitis complicating homologous serum hepatitis and of ileocecal intussusception complicating the cecitis. The author makes use of the literature to support the contention that inflammation, hemorrhages, and even ulcerations in the esophageal and intestinal wall are not rare in liver disease, particularly in subacute hepatitis.—*David D. Beiler, M.D.*

Palazzo, William L., and Schulz, Milford D. Spindle-cell tumors of the gastro-intestinal tract. *Radiology*, Dec., 1948, *51*, 779–789.

This study has investigated (1) the incidence of spindle cell tumors in the gastrointestinal tract; (2) the prospect for the patient in whom such a tumor is found; (3) what, if any, roentgenological criteria there may be to aid in diagnosis, particularly in distinguishing between benign or malignant lesions.

Eight tables are presented with illustrations

of characteristic roentgen findings as well as the criteria for roentgen diagnosis.

Spindle cell tumors of the gastrointestinal tract were found in 0.67 per cent of 12,000 necropsy protocols and in 1.2 per cent of 5,313 surgical records at the Massachusetts General Hospital. Both benign and malignant varieties occurred with increasing frequency as age progressed.

Of the total of 140 spindle cell tumors, 12, or 9 per cent, were located in the esophagus; 93, or 65 per cent, in the stomach; 23, or 17 per cent, in the small intestine and 12, or 9 per cent, in the large intestine.

Spindle cell tumors accounted for 2.3 per cent of all tumors surgically removed from the esophagus in the past sixteen years; for 5 per cent of those in the large intestine.

Of the spindle cell tumors found in the esophagus, 33 per cent were malignant. In the stomach, 36 per cent were malignant, and 54 per cent of the patients bearing the tumors remained well and free of disease for an average of eight years. Recurrence or metastasis, if present, was evident within four years. Metastases to the liver and lymph nodes occurred in 33 per cent of the malignant gastric tumors. In the small bowel 77 per cent of the spindle cell tumors were malignant; none of the patients remained free of disease for longer than three years. Eighty-six per cent of the spindle cell tumors in the large bowel were malignant. Only 1 patient of this group is alive; she is without disease five years after operation.

This study has not demonstrated any safe criteria by which the benignity of a spindle cell tumor may be recognized with certainty. Similar morphologic and growth characteristics are shared by both benign and malignant tumors. Some spindle cell tumors, obviously malignant, may not be roentgenologically recognized as spindle cell in type but may be mistaken for carcinomas.

In the authors' experience, recognition of spindle cell tumors as such has not proved to be as satisfactory in the small and large intestine as in the esophagus and stomach.—*Norman Heilbrun, M.D.*

GYNECOLOGY AND OBSTETRICS

SPEERT, HAROLD. Corpus cancer; clinical, pathological, and etiological aspects. *Cancer*, Nov., 1948, *1*, 584–604.

The subject of corpus cancer, with special reference to possible causative factors is well discussed and an extensive bibliography is appended. The conclusions are based mainly on statistical evidence.

Glandular hyperplasia of the endometrium is a common precursor of adenocarcinoma, but does not justify radical treatment. The association of uterine myomas with endometrial carcinoma is coincidental and there is no specific relationship between the tumors. Incidence of cervical polyps is higher in corpus cancer and therefore avulsion of a polyp in a case of abnormal bleeding should be accompanied by a curettage of the fundus.

The unexplained relative frequency of other associated tumors (breast and ovary), together with the frequent finding of endometrial hyperplasia, offers support to the view that prolonged and unmodified estrogenic stimulation favors the development of endometrial cancer.—*M. M. Manalan, M.D.*

MARRUBINI, GILBERTO. Doubtful malignant changes in the endometrial epithelium. *Acta radiol.*, Jan., 1949, *31*, 65–84.

The occurrence of these pseudo-malignant lesions in the postmenopausal period should be regarded as more suspicious than at the menopause or in the reproductive period. This fact is substantiated by the finding that 5 of the 6 patients who developed a true carcinoma had passed the menopause.

Twenty-four cases showed an endometrium of a functioning type. Of these only one case later developed unmistakable adenocarcinoma. On the other hand, suspicious changes were found in 3 of the recurrent cases of polyps and in 2 atypically hyperplastic non-functioning endometria. This finding seems to indicate that the suspicion aroused by these pseudo-malignant lesions is graver in cases showing endometrial polyps or atypical glandular proliferations in a non-functioning endometrium than in cases with an endometrium of functioning type.

Although it cannot be definitely stated that all the lesions would finally have become frankly malignant, radical treatment seems justified. It is the writer's opinion that if radical treatment had not been given the number of cases which developed adenocarcinoma would have been higher.—*Mary Frances Vastine, M.D.*

MARTZLOFF, KARL H., and MANLOVE, CHARLES H. Vaginal and ovarian metastases from hypernephroma. *Surg., Gynec. & Obst.*, Feb., 1949, *88*, 145–154.

A case is reported in which bleeding from vaginal metastases was the first symptom of an unsuspected left renal hypernephroma. The case presumably represents the twenty-third instance of vaginal metastases complicating hypernephroma reported in the literature. The complication is generally limited to tumors of the left kidney, although exceptions are reported.

All patients with hypernephroma complicated by vaginal metastases, whose ultimate outcome is known, died as the result of the hypernephroma with the exception of those who died at operation. It is assumed that metastases ordinarily occur via venous channels. Communication of the left ovarian vein with the left renal vein proximally and the pampiniform plexus and uterovaginal plexus distally explains the peculiar predilection for vaginal metastases to occur with tumors of the left kidney. The suggestion is offered, therefore, that if the venous theory of dissemination is correct, then left testicular metastases should occur in men afflicted with a left hyperhephroma.

This analysis also suggests that in the event a hypernephromatoid vaginal metastasis is diagnosed in a patient who shows no other demonstrable or conclusive evidence of renal tumor, an exploration of the left kidney becomes a logical and therefore justifiable procedure.—*Mary Frances Vastine, M.D.*

Pulsford, Jean, and Palmer, Raoul. Résultats de l'hystérosalpingographie aux organo-iodés hydro-solubles visqueux. (Results in hysterosalpingography with viscous hydrosoluble organic iodide substances.) *J. de radiol. et d'électrol.*, No. 11–12, 1948, *29*, 605–609.

This is a continuation of the authors' previous work in developing a technique for optimum hysterosalpingography with opaque material much less viscous than lipidol or the presently popular opaque material used in the United States for this type of contrast study (ray-opaque). The material used in the beautiful roentgenograms of injected uterus and tubes shown in this article is not an oil at all but a water-soluble iodized organic compound. The special technique (for injection and roentgenography) required because of this is enumerated.

Some of the remarkable advantages of the technique and use of the compounds reported by these workers are: (1) complete elimination of any danger of fat emboli, (2) such perfect spread of the material after first cubic centimeters that one gets a good image of the entire uterine cavity where the mucosal pattern can be faintly outlined, (3) most important of all, a cervical cannula is not needed. The substance can be controlled by the manometer pressure and the space formerly taken up by the cervical cannula can now be studied for filling defects, i.e., early endocervical lesions can be found.

Pulsford (radiologist) and Palmer (gynecologist) work at the Hôpital Broca, the gynecological center of Paris, and this abstractor observed their work with a less viscous lipiodol in early November, 1945. The present substance (judging from the illustrations in this article) further improves the well-nigh perfect technique of these experts.—*William M. Loehr, M.D.*

GENITOURINARY SYSTEM

Rennoes, Selmer. On double renal pelvis and ureteral calculus. *Acta radiol.*, Jan., 1949, *31*, 37–43.

Forty-nine cases of double renal pelvis were encountered in 3,279 urographies, i.e, in 1.5 per cent. In 10 patients there was present a ureteral calculus on the same side as the double pelvis. It was found that when the calculus was situated in the common ureter the excretion of the contrast medium was impaired in the entire kidney. A stone in one of the branches of a double ureter was found to cause delayed secretion or an accumulation of contrast medium in the renal parenchyma corresponding to the occluded branch. Nothing to support the existence of a homolateral reflex calculus anuria in the non-affected portion of the kidney was brought out.—*Mary Frances Vastine, M.D.*

Howze, C. P., and Hill J. H. Unilateral multiple cysts of the kidney. *J. Urol.*, Feb., 1949, 61, 187–193.

Braasch and Hendrick proposed the following classification of renal cysts:

1. Retention or inflammatory cysts.
2. Simple cysts.
3. Pyelogenic cysts.
4. Parapelvic cysts.
5. Cysts secondary to renal disease.
6. Polycystic kidneys.

The authors report 2 cases of unilateral polycystic kidneys and summarize the liter-

ature. Six cases have been reported in children and with the authors' 2 cases increases the number to 8.

The authors question the long-accepted theory of the origin of renal cysts as being due to failure of union of nephroblastemic elements and the collecting tubules. They quote the experimental work of Hepler in support of their belief that cysts develop from interference with blood supply. In infants with congenital cystic disease at birth fetal arrest of development of the renal artery and pelvis has been found.—*Rolfe M. Harvey, M.D.*

NERVOUS SYSTEM

HOLT, JOHN F., and WRIGHT, EDWIN M. The radiologic features of neurofibromatosis. *Radiology*, Nov., 1948, *51*, 647–664.

A report of 127 cases of neurofibromatosis occurring in 245,219 new admissions with no important difference between the sexes and no significant racial distribution. Age varied from six weeks to seventy-seven years with familial incidence in 9 cases.

The pathology is discussed. Masson is quoted as being able to show by special stains that all pigmented nevi are true "nerve ending neuromas." Pigmented nevi and the café au lait spots are indistinguishable histopathologically. Seven cases with malignant change, an incidence of 5.5 per cent, occurred in this series.

Bone changes occurred in 37 cases, but 50 cases had no roentgen study of the skeleton. Erosive changes produced saucer-shaped defects (the pit or cave defects of Nørgaard). In 2 cases the defects were in ribs simulating the erosions seen in coarctation of the aorta. Scoliosis was produced by erosive changes in the vertebrae. The mechanism by which overgrowth of bones is produced is probably best explained by increased blood supply resulting from lymph stasis. The method by which erosive bone changes occurs is a matter for conjecture. The present state of knowledge does not seem to justify the outright conclusion that congenital bowing and pseudoarthrosis of a lower leg is pathognomonic in this disease. These patients present a difficult orthopedic problem until puberty when the chance of successful bone graft increases. Multiple intraosseous cystic lesions are discussed with one four months old child showing spontaneous disappearance of the bone and skin lesions in thirteen months.

Associated anomalies were infrequent in this series. Two cases presented orbital wall defects.

Differential diagnosis is discussed.—*J. Maxey Dell, Jr., M.D.*

SMITH, MARCUS J., and STENSTROM, K. WILHELM. Compression of the spinal cord caused by Hodgkin's disease. *Radiology*, July, 1948, *51*, 77–83.

Eleven cases of spinal cord compression caused by Hodgkin's disease were observed at the University of Minnesota Hospital during the period 1926–1947. During that same period, 305 cases of Hodgkin's disease were treated by the Radiation Therapy Department of the Hospital.

Pain in the back with radicular distribution in the presence of Hodgkin's disease should warn of impending paraplegia.

The object of treatment is to prevent paraplegia, but with paraplegia already present, laminectomy and intense deep roentgen therapy are indicated. Detailed case reports are given and experiences with treatment are discussed.—*Richard E. Kinzer, M.D.*

SKELETAL SYSTEM

POMERANZ, MAURICE M. Werner's syndrome. *Radiology*, Oct., 1948, *51*, 521–524.

To the 12 previously reported cases of this rare condition, Pomeranz adds one which was diagnosed roentgenologically prior to clinical investigation. The condition was recognized when study of the roentgenograms revealed a normal denture with intact peridontal membranes in contrast to striking evidence of senility in the bones and vessels of the extremities in a woman aged thirty-five.

The clinical picture in this condition is briefly reviewed.—*George Cooper, Jr., M.D.*

KHANOLKAR, V. R. Reticulum cell sarcoma of bone. *Arch. Path.*, Nov., 1948, *46*, 467–476.

This paper is a presentation of 5 cases of primary reticulum cell sarcoma of bone from the Tata Memorial Hospital in Bombay, India, with several photomicrographs but only one roentgenogram.

The cases were all young in men ranging from twenty to thirty-eight years old. Four of the 5 men had a relatively long (4 to 18 months) history of pain and disability when first seen. These were treated with roentgen rays; the fifth died too soon to be treated. The author reports

that the local lesion always responded well, but he is very vague about the dosage. There were follow-ups on only 2 of the 4 treated, 1 being well after three years, the other dead in two months. Nevertheless, as the author states, the prognosis is relatively good as compared to other primary bone sarcomas.

The tumor is characterized as being a distinct pathological entity, chiefly affecting persons under forty. It is typically painful, but progresses slowly, infiltrates locally, and metastasizes late (to the bones and regional lymph nodes). The patient often shows remarkable well-being even with an advanced lesion.

The roentgenographic changes are nonspecific, but the tumors are almost purely osteolytic. The tumor is usually radiosensitive and perhaps sometimes radiocurable; it is often amenable to surgery if irradiation fails because it remains localized for so long.—*David D. Beiler, M.D.*

Jacobson, H. H., and Vraa-Jensen, G. Fibrous dysplasia of bone. *Acta radiol.*, Jan., 1949, *31*, 1–16.

Roentgen Appearance. The site of predilection appears to be the long bones of the legs but the lesion has been met with in all bones. The roentgen manifestations are usually central cyst-like areas of translucency, usually vaguely defined and, as a rule, containing rather coarse trabeculae.

In most cases the changes are found in the metaphysis or in the middle of the bone. If they do involve the epiphysis the joint surface is spared. The process may erode the cortex from within causing it to expand and get thinner than the normal.

Localized zones of sclerotic bone may be found in between the osteoporotic areas. The sclerosis may even dominate as in the anterior part of the base of the skull and in the maxilla. In between the affected bones the structure is normal.

The bones may grow more rapidly than normal and thus attain an abnormal length. On the other hand, there is often premature epiphyseal closure, with resulting shortening. There may be deformities such as bowing of the long bones.

In the anterior part of the base of the skull and in the maxilla the disease is of special character manifesting itself in the form of proliferation of dense bone gradually filling up the accessory nasal sinuses and often causing a thickening of the orbital roof which in turn results in protrusion of the eyeball.

Summary. Fibrous dysplasia of bone is a condition primarily characterized by a proliferative connective tissue process in the medullary cavity of the bones affecting one or more bones. Extensive bony involvement may often be unilateral and frequently combined with areas of abnormal pigmentation of the skin, early onset and early arrest of bone growth and —in females—precocious puberty. It has a benign course. It may be impossible to make a diagnosis on the basis of the roentgen findings whereas the histopathological picture is well defined. The etiology is doubtful. The writers report 5 cases of their own.—*Mary Frances Vastine, M.D.*

Fairbank, H. A. Thomas. 7. Diaphysial aclasis. Synonyms—multiple exostoses, hereditary deforming chondrodysplasia. *J. Bone & Joint Surg.*, Feb., 1949, *31B*, 105–113.

This article is a review of the condition known in Britain as diaphysial aclasis, the term given it by Keith (1919). In it, the first portion is devoted to a definition of the disease condition. It is characterized by the presence of cancellous exostoses capped with cartilage, and by failure on the part of the periosteum to model the metaphyses of long bone in a normal manner. Diaphysial aclasis and dyschondrosplasia are often regarded as variations of one and the same developmental error and they are frequently confused, but with little if any justification. Both result from a fault of the epiphysial plate-nests of cartilage becoming misplaced, instead of being calcified and ossified in the normal manner—but roentgenographically they are quite different and in the vast majority of cases they are distinguishable without the slightest difficulty. Exostoses are outgrowths of cancellous bone on the surface of the parent bone: dyschondroplasia, on the other hand, is characterized by columns or masses of cartilage lying inside the metaphysis, the lesions being essentially endosteal.

Hereditary and familial influences play a definite part in the incidence. Of the reported cases, two-thirds are in males. Although sometimes it is present at birth, it seldom causes trouble before the age of six years and perhaps not till after growth has ceased. The cause is unknown.

The incidence, symptoms and signs, roentgenographic appearances, pathology and the

progress and complications are discussed under separate headings. Excellent roentgenograms of 5 cases are reproduced.

Fairbank thinks that it would seem wise, at present, to admit that although the fact of occasional development of a chondrosarcoma from the cap of an exostosis must be accepted, the frequency of this complication is unknown. Some cases are undoubtedly malignant, the bones most likely to be affected being the femur, the scapula and the pelvis. It is not always easy to determine whether a large chondromatous or chondrosarcomatous tumor has arisen endosteally or in the cartilage cap of an exostosis.—*R. S. Bromer, M.D.*

FAIRBANK, H. A. THOMAS. 8. Dysplasia epiphysialis punctata. Synonyms—stippled epiphyses, chondrodystrophia calcificans congenita (Hünermann). *J. Bone & Joint Surg.*, Feb., 1949, *31B*, 114–122.

The chief characteristic of this rare disorder of infancy is the presence of a number of discrete centers of unusual density in many cartilaginous epiphyses and apophyses. The title used by Fairbank seems to be the one preferred in the British literature. The title favored in other countries is "chondrodystrophia calcificans congenita." Fairbank had 16 cases for study.

Hereditary and familial influences, incidence in regard to sex and age and clinical signs are discussed. The roentgen appearances are described in detail. The epiphyses are generally stippled, as if ossifying from many separate centers, the appearance being suggestive of that produced by flicking paint from a brush on to a clean surface. The spots vary in size, but most of them are minute and usually discrete. They also vary considerably in number, and are not always more numerous in older than in younger children. There is evidence in some cases that the spots may become gradually smaller and fewer in number. On the other hand, they may show a tendency towards fusion, with the formation of a single, more normal center of ossification. Often they appear at an earlier date than that at which ossification normally begins in the epiphysis concerned; and they may appear too early by several years. The epiphyses most frequently showing the typical stippled appearance are those of the upper and lower ends of the femur, upper end of the tibia, and upper end of the humerus. The lower end of the tibia, both ends of the fibula, the lower ends of the radius and ulna, and the bones of the hand, are much less frequently affected.

Half of the patients studied are known to have died, all but one before reaching the age of twelve months. The causes of death were infections involving the lungs or kidneys, and miliary tuberculosis; while in one case, death occurred suddenly for no reason which was discovered.

Excellent roentgenograms of 5 cases are reproduced.—*R. S. Bromer, M.D.*

KHOO, F. Y. Congenital pseudarthrosis of the tibia and its relation to fragilitas ossium. *Am. J. Dis. Child.*, Feb., 1949, *77*, 201–216.

A case of so-called congenital pseudarthrosis of the tibia in a boy of French origin is reported. Roentgenograms showed pronounced atrophy, with deformity of the involved bones of both legs, resulting in a condition not unlike that seen in fragilitas ossium. Repeated bone graftings were unsuccessful in effecting firm union.

A comprehensive review of the various aspects of congenital pseudarthrosis is included, particular stress being laid on etiologic factors and surgical treatment. Pseudarthrosis implies the formation of a false joint, usually following a fracture, with no attempt at repair. It occurs in adults and children. The sites of election are mainly confined to the following bones: the tibia or fibula, usually the lower portion, and less often the upper third of the femur, the upper and middle thirds of the clavicle and humerus and the lower part of the forearm. Most observers have expressed the belief that the condition is brought about by some modification in the blood supply (poorer vascularity of the lower half of the tibia) together with the gorilla-like stance of childhood, whereby the greatest stress is directed on the junction between the middle and the lower third of the tibia. While reviewing published roentgenograms, the author was struck by the similarity in appearance between some cases of congenital pseudarthrosis of the tibia and certain types of bone dystrophies and malacias. Particularly striking, he thought, was the resemblance to fragilitas ossium, especially the form localized to one or two regions. It has been demonstrated that delayed union, and even presistent nonunion, of fractures can sometimes occur in fragilitas ossium, and that this may occasionally end in pseudarthrosis. The resemblance between congenital pseudarthrosis of the tibia

and fragilitas ossium would be more complete were it not for the fact that in hardly any case of congenital pseudarthrosis of the tibia so far reported were there the hereditary qualities so characteristic of fragilitas ossium: blue scleras, deafness and hyperlaxity of ligaments, among other signs. However, when one recalls that even in some cases of fragilitas ossium non-hereditary features are present, the evidence suggesting that congenital pseudarthrosis of the tibia is in all probability a variant of the fragilitas ossium group seems stronger than ever.

The treatment of congenital pseudarthrosis of the tibia is beset with difficulties, apparently because of the inferior quality of the atrophic and dystrophic bony tissue present. Operative successes were reported in less than half of all cases, and failures seem to be the rule when children of eight years of age or under are treated surgically. For this reason, many surgeons advise deferring operation until adolescence. Khoo suggests that with more modern techniques, in combination with other recent advances in orthopedic surgery, operations performed even in early childhood should have a better chance of firm bony union than was possible in the past.—*R. S. Bromer, M.D.*

Goldman, Q. R. Congenital malformation of the vertebrae (hemivertebrae) with aplasia of corresponding ribs, associated with a lateral meningomyelocele. *Arch. Path.*, Feb., 1949, *47*, 153–159.

An interesting case report involving a white boy dying neonatally with hemivertebrae from D-1 through D-9, absence of the first nine ribs, fusion of the last three ribs, and a large right-sided thoracic meningomyelocele. The author presents a clearly illustrated brief discussion of the pertinent embryology.—*David D. Beiler, M.D.*

Donahue, C. D. Osteitis of the spine. *J. Urol.*, Feb., 1949, *61*, 405–409.

The author believes that osteitis of the spine sometimes follows prostatic surgery. He postulates that the infection spreads to the spine through the vertebral veins, a method of transmission suggested by Batson in the spread of prostatic malignancy.

The author reports 2 cases with illustrative roentgenograms tracing the course of the disease. The final result with complete healing rules out metastatic malignancy as the cause of the changes.—*Rolfe M. Harvey, M.D.*

Parke, W., Colvin, G. S. and Almond, A. H. G. Premature epiphysial fusion at the knee joint in tuberculous disease of the hip. *J. Bone & Joint Surg.*, Feb., 1949, *31B*, 63–73.

This review was undertaken to determine the present incidence of premature epiphysial fusion in children who had been treated for tuberculous disease of the hip by prolonged conservative measures, and to study the relationship of this complication of the disease, the changes which precede and accompany premature fusion, and the possibilities of earlier recognition and prevention.

The authors conclude that, in tuberculous disease of the hip, premature epiphysial fusion at the knee joint is due to rupture of the epiphysial cartilaginous plate consequent upon resorption of cancellous support and suppression of osteogenesis.

In the tibia, premature fusion is usually preceded by near-central "bulging" of the metaphysial and tibial marrow through the epiphysial plate. In the tibial epiphysis, a central translucent area appears to the inner side of the midline above the point of strut decussation, and enlarges upwards towards the articular cartilage and downwards towards the terminal bone plate. The terminal bone plate, the thinned cartilaginous plate, and the growth retardation line, together with the medullary contents of the shaft, then bulge upwards into this translucent area. This may be called, the authors suggest, the pre-fusion stage because premature fusion, though likely to follow, is not inevitable. Premature fusion is inevitable when the limiting structures of the bulge rupture, and turn up like a flap into the translucent area in the epiphysis. This allows the semi-fluid medullary contents of the epiphysis and diaphysis to intermingle and establish a channel through which the blood supply of both can become continuous, now that the barrier of avascular cartilage has been removed. The laying down of bone trabeculae through this channel is not seen until a later date.

In the femur, epiphysial changes preceding fusion are of a fragmentary type. This type of fusion is preceded by intense osteoporosis. Translucent areas appear, centrally in the diaphysis of the femur, and both subcortically and centrally in the epiphysis. Premature fusion is indicated by the appearance of many

small isolated fragments of calcific material replacing the crenated line of the terminal bone plate which normally is well defined and continuous. The thinned epiphysial cartilage plate disappears altogether in the area affected, and irregular linear shadows may be seen in the diaphysis. In some cases there was difficulty in making certain that the cartilaginous plate was in fact obliterated, and that a false appearance was not being created by overlapping shadows. Oblique exposures were sometimes helpful but, where the evidence was uncertain, repeated roentgenographic examination was made of the epiphysial lines. In securing early evidence of fusion, this was more valuable than roentgenographic estimations of bone lengths.

Injury, in quiescent disease, the authors conclude, plays little or no part in the causation of premature epiphysial fusion. The factors which are responsible for these changes—local toxemia and prolonged immobilization—must exist for not less than two years. In cases which are treated conservatively for long periods of time the incidence of premature fusion, with shortening of the limb, is so high that the wisdom of such treatment must be reconsidered.—*R. S. Bromer, M.D.*

WEST, EDMOND F. Intrathoracic dislocation of the humerus. *J. Bone & Joint Surg.*, Feb., 1949, *31B*, 61–62.

The case is reported of a Chinese male, aged twenty-seven, who fell a distance of approximately 20 feet. His outstretched arm struck a plank as he fell. He landed on the outstretched limb. On physical examination immediately after the injury, the arm was projecting horizontally from the body and the patient resented any movement. He was admitted to the hospital four hours after the injury. Prominence of the acromion process was noted and also downward displacement of the head of the humerus. Surgical emphysema was present over the whole anterior chest wall. No nerve lesion could be detected. Roentgen examination showed that the head of the humerus was displaced from the glenoid cavity and lay inside the thoracic cavity, the surgical neck being gripped between the third and fourth ribs. A large fragment was avulsed from the greater tuberosity and remained approximately in its normal position.

A search of the literature failed to reveal any record of a similar displacement of the humeral head in cases of dislocation of the shoulder joint. When the fall on the outstretched arm and hand occurred, the head of the humerus was driven between the ribs into the thoracic cavity. Previously while falling, violent abduction forced the humeral head through the lowest and weakest portion of the capsule to the level of the third and fourth rib interspace. The greater tuberosity was doubtless avulsed by the supraspinatus tendon.

After applying traction, the arm was brought to the side. The head of the humerus returned to a subcoracoid position and was easily replaced by Kocher's method.—*R. S. Bromer, M.D.*

KENNEDY, JOHN, C. Retrosternal dislocation of the clavicle. *J. Bone & Joint Surg.*, Feb., 1949, *31B*, 74–75.

Retrosternal dislocation of the clavicle is an unusual type of injury. The patient reported in this paper was injured by a fall on the right shoulder. He felt a painful buckling sensation at the inner end of his left clavicle. During the next three days he complained of severe pain in the region of the sternoclavicular joint, a tight feeling in his throat, and difficulty in swallowing. His mother noted that, for the first time in his life, he snored when asleep. The skin over the clavicle was discolored and there was generalized swelling. Roentgenologic examination confirmed the clinical diagnosis of retrosternal dislocation.

Serious complications may arise from damage to the trachea, the great vessels of the mediastinum, the esophagus and the thoracic duct. Operative reduction and reconstruction of the ligaments is the most reliable treatment.—*R. S. Bromer, M.D.*

TUCKER, F. R. Arterial supply to the femoral head and its clinical importance. *J. Bone & Joint Surg.*, Feb., 1949, *31B*, 82–93.

The author studied the arterial supply of the upper end of the femur in 24 children and 20 adults. The arterial system was demonstrated by injection of radiopaque material, with Spalteholz' method of clarification, and histological section of the neck and ligamentum teres. The upper end of the femur is supplied by the nutrient artery of the shaft, the retinacular vessels of the capsule, and the foveolar artery of the ligamentum teres. The retinacular vessels consist of three separate groups: posterosuperior, posteroinferior and anterior. These vessels are the chief supply to the epiphysis and

the femoral head in all ages. The foveolar artery constitutes a small and subsidiary blood supply to the femoral epiphysis. In Tucker's series it penetrated the cartilaginous or osseous head in 33 per cent of young specimens and 70 per cent of adult specimens.

In fractures of the neck of the femur, every effort should be made to avoid damage to the foveolar arteries. It is difficult to estimate the frequency with which the adult femoral head can be nourished fully by the foveolar artery. There is a variable foveolar supply in 70 per cent of cases, the vessels being capable of maintaining the nutrition of the whole femoral head in some cases, and of no more than a limited area near fovea in others. In the other 30 per cent, loss of the retinacular supply would be expected to cause avascular necrosis.

In regard to avascular necrosis following the insertion of a Smith-Petersen nail, any object driven into the bone near the fovea may disrupt the foveolar vessels. Insofar as the anterior part of the head receives its blood supply usually from the posterior set of retinacular vessels, a large centrally placed object may sever intra-osseous arteries. The foveolar vessels are most prone to damage if the nail is near the fovea and is placed with its tip flush with the articular surface.

Avascular necrosis after traumatic dislocation of the hip joint, due to rupture of the retinacular vessels in cases where there is no adequate anastomosis between these vessels and the nutrient artery, must be expected to occur more frequently in children than in adults. In children no nutrient vessel was detected crossing the epiphysial line from the metaphysis to the epiphysis. In some adults, however, there was such anastomosis.

Tucker believes that the posterosuperior group of vessels is susceptible to pressure from the acetabular lip and its labrum in positions of forced abduction and external rotation of the hip, and that it is individuals with this pattern of vascular supply who are most prone to avascular necrosis as found in Perthes' disease.

He also suggests that it is the posterosuperior vessels which are most liable to damage in congenital dislocation of the hip. Fragmentation of the epiphysis has been observed after reduction in the sound hip when fixed in full abduction and external rotation, but not when this joint has been left free.

Avascular necrosis is not a frequent complication of the type of epiphyseolysis of the hip which is gradually progressive. It does occur, however, in the acute traumatic type and in cases treated by vigorous manipulative or operative reduction. The posteroinferior group of vessels, which are even more mobile than the posteriosuperior group, are more likely to be injured by forcible manipulative reduction than by gradual stretching due to progressive displacement of the epiphysis.—*R. S. Bromer, M.D.*

BLOOD AND LYMPH SYSTEM

Legant, Omar, and Ball, Robert, P. Sickle-cell anemia in adults; roentgenographic findings. *Radiology*, Nov., 1948, *51*, 665–675.

Sickle-cell anemia occurs almost solely in the Negro race. It is estimated that 7 per cent of the Negro population show sickling and of this 7 per cent 1 to 2 per cent develop a severe hemolytic anemia. Most cases die in infancy and childhood with the terminal clinical picture described as one of extreme prostration, peripheral vascular collapse and shock. Necropsy findings are mainly vascular lesions, infarction, thrombosis, and focal areas of necrosis.

The clinical and roentgen findings of 226 cases are discussed in detail. Positive roentgen findings were enlarged heart—13 cases, generalized osteoporosis—11 cases, and the other abnormalities in bone—17 cases. The prominent clinical findings were indolent ulcers of the leg, abdominal crisis and the laboratory findings. An unusual case is reported in which a serial roentgenographic study was made of an infarction of two vertebral bodies from its inception to a healing stage.—*J. Maxey Dell, Jr. M.D.*

Macht, Stanley H., and Roman, Paul W. The radiologic changes in sickle-cell anemia. *Radiology*, Nov., 1948, *51*, 697–707.

The point is emphasized that sickle-cell anemia is a systemic disease and may manifest itself in many ways, so that the roentgen studies should be rather complete. The more common findings have been cardiac enlargement, lung changes believed to be a pneumonia, and skeletal disturbances involving the long bones. The findings are summarized in a study of 48 cases of proved sickle-cell anemia in the Baltimore City Hospital over a period of eleven years. Cases of sickle-cell trait (sicklemia) without anemia were excluded from the series.

The roentgenologic changes are summarized and classified as follows:

I. Roentgenographic Evidence of Involvement of the Viscera
   (a) Cardiac enlargement
   (b) Pathological changes in the lungs
   (c) Enlargement of the liver; cholelithiasis
   (d) Enlargement of the spleen in children—possible calcifications later in life.
II. Skeletal Changes Due to Hyperplasia of the Erythroblastic Elements
   (a) Long bones
      1. Irregular trabeculation
      2. Widening of the medullary spaces
      3. Cortical thinning
   (b) Short bones and flat bones
      1. Exaggeration of trabecular markings of ilia, scapulae, phalanges
      2. Cupping of vertebral bodies
      3. Skull: Widening of diploe, thickening of parietal and frontal bones, thinning of outer tables, and radial arrangement of trabeculae
III. Skeletal Changes Due to Thromboses
   (a) Long bones
      1. Cortical thickening
      2. Narrowing of medullary cavity
      3. Loss of bone tissue
      4. Periosteal reaction
   (b) Short bones
      1. Necrosis and resorption of bone.
      2. Periosteal reaction
IV. Skeletal Changes Due to Disturbances of Growth

The authors believe that the findings, while not specific for sickle-cell anemia, are sufficiently prominent for the radiologist to suggest the diagnosis to the clinician.—*Paul R. Dirkse, M.D.*

ROENTGEN AND RADIUM THERAPY

LARSSON, LARS-GUNNAR. Tubercle-like structures in late irradiation injuries of the skin. *Acta radiol.*, Jan., 1949, *31*, 17–27.

Pronounced tubercle-like changes in late irradiation injuries of the skin are described in 26 cases. With one exception, they followed radium implantation. These changes are regarded as a peculiar type of tissue reaction due to advanced regressive changes in the connective tissue. Microscopically the changes closely resemble the granulation tissue in tuberculosis and clinically there are often small nodules which may be mistaken for recurrences of carcinoma.—*Mary Frances Vastine, M.D.*

BRAASCH, NANCY K., and NICKSON, MARGARET J. A study of the hands of radiologists. *Radiology*, Nov., 1948, *51*, 719–727.

During the annual meeting of the Radiological Society of North America in 1946 a voluntary study of the hands of radiologists was undertaken.

The methods of study were by impression of finger tips in Kerr dental compound for epidermal ridges and capillary microscopy of nailfold areas of the fingers.

Three hundred and twenty-three radiologists were examined. Forty-eight per cent showed epidermal ridge abnormalities by the wax impression method and of 152 radiologists with capillary microscopy 138 showed deviations from the simple normal pattern of capillaries in the nail-folds.

Conclusions drawn from wax impression studies were that the type of practice appears to have less effect on epidermal ridges than the number of years of exposure. A significant increase in epidermal ridge changes occurs beyond fifteen years of practice.

Various tables are included showing percentages of total numbers in other similar studies as compared with the present and inclusion of personnel other than radiologists who are actively engaged in working with radioactive materials. Years of exposure are tabulated in 5 year intervals from 0 through 45 years for radiologists. Tables included showing comparison with type of exposure as roentgen rays and radium, roentgen rays only or radium only and a table is included showing type of protection used by radiologists.

Under the second method of examination, that of capillary microscopy, tables are included showing the number of individuals, number with abnormalities, distribution of abnormalities and the type of abnormalities.

The authors conclude there appears to be no single capillary abnormality pathognomonic of radiation damage and that the changes which occur as seen by capillary microscopy are morphologically indistinguishable from the changes found in the normal individuals, but the changes appear to be induced at an earlier age among radiologists than among unexposed persons. No radiologist who had practiced thirty years or more had normal nail-fold vessels although normal vessels were seen in aged persons.—*John H. Gilmore, M.D.*

BURCHENAL, J. H., MYERS, W. P. L., CRAVER, L. F., and KARNOFSKY, D. A. The nitrogen mustards in the treatment of leukemia. *Cancer*, Jan., 1949, *2*, 1–17.

Conclusions from the study of 38 cases of leukemia, 33 of which were the chronic form, are used to define the place of nitrogen. The majority of cases were treated with methyl-bis amine in the dose of 0.1 mg. per kilogram of body weight, intravenously daily for four doses. A few cases were given 0.2 mg. per kg. of HN_2 and other cases received courses of methyl-tris amine.

1. All forms of therapy become less effective late in disease, regardless of previous treatment.

2. The poorer the condition of the patient, the less effective the treatment.

3. Arsenic, benzene, urethane, irradiation, radiophosphorus and nitrogen mustards give about the same therapeutic effectiveness. Advantages of nitrogen mustards:

1. Can be given by one clinician by the simple intravenous route.

2. The nausea and vomiting that are frequently protracted over a period of a month in other forms of therapy are only present on four days of nitrogen mustard therapy. Occasionally if the tolerance to HN_2 is known, a full course may be given in one injection.

The results were most favorable in chronic myelocytic leukemia and were not constant in any acute leukemia. Any case that has become resistant to one form of therapy should have the advantage of an alternate method of treatment.—*David C. Gastineau, M.D.*

DEL REGATO, J. A. Roentgen therapy of carcinoma of the lower lip. *Radiology*, Oct., 1948, *51*, 499–508.

Though surgical excision, radium therapy, and roentgen therapy have all been used successfully in the treatment of carcinoma of the lower lip, roentgen therapy is, in the author's opinion, the treatment of choice in most cases.

The surface application of radium requires meticulous planning and surveillance with no better results than may be obtained more easily by other methods. Interstitial curie therapy offers no special advantage and is followed by undue atrophy.

Surgical excision may be preferred for small tumors requiring removal of less than one-fourth of the free border of the lip and for advanced lesions that have already produced a large defect which will ultimately require plastic surgery.

In other cases, this author prefers roentgen therapy and describes his technique for different types of primary lesions.

In regard to metastatic adenopathies, he states that effective radiotherapy is difficult to attain and should not be attempted except in inoperable cases. Prophylactic neck dissection is usually justified only when the primary lesion is anaplastic and has been unsuccessfully treated. When metastatic nodes are adherent to the mandible, a combined jaw resection and neck dissection offers good hope of control. In other cases, supra-omohyoid neck dissection ordinarily suffices.

The author's results in a series of 195 cases are presented.—*George Cooper, Jr., M.D.*

CUTLER, MAX. Cancer of the larynx. *Radiology*, Oct., 1948, *51*, 509–520.

The author, reporting a series of 107 consecutive unselected cases of laryngeal cancer treated by radiotherapy, brings up to date his previous discussions of "concentration" treatment. He describes modifications in technique, more exact criteria for selection of surgery or radiation, and tabulates his results.

Thirty-five per cent five year cures were obtained in this series of which more than half were inoperable cases. Among the operable cases too extensive for laryngofissure radiotherapy effected 52 per cent five year cures. In the totally inoperable group, 20 per cent are free of disease after five years. The five year curability among the cases in which the cords were freely movable or incompletely fixed is 60 per cent.—*George Cooper, Jr., M.D.*

HARRIS, WILLIAM; KRAMER, RUDOLPH, and SILVERSTONE, SIDNEY M. Roentgen therapy for carcinoma of the larynx. *Radiology*, Nov., 1948, *51*, 708–718.

Eighty cases of carcinoma of the larynx treated by roentgen therapy at Mount Sinai Hospital, New York between the years 1931 and 1942 are analyzed.

During preliminary discussion the authors state that various reports dealing with radiation treatment of cancer of the larynx have been discounted because the material was said to have been selected. They asked the question "what radiotherapist selects his material?"

In this series, study of age distribution showed an increasing incidence from the third decade onward with the peak incidence in the sixth and seventh decades.

All patients referred for radiation therapy are included in this report regardless of the extent

of disease or whether or not treatment was completed.

In spite of the authors' belief that the present classification of carcinoma of the larynx into intrinsic and extrinsic groups is unsatisfactory, they have used this classification as follows. Intrinsic group: Lesions involving only ventricle, true cords, the anterior commissure, the posterior commissure of the subglottic region. Extrinsic group: All lesions involving the epiglottis, aryepiglottic fold, the ventricular bands (false cords), the arytenoids, the piriform sinuses or the postcricoid region.

Of the 80 cases treated primarily by roentgen therapy 36 were intrinsic and 44 extrinsic according to this anatomic classification.

In the five year analysis 13 cases were indeterminate for various reasons.

Sixty-seven cases were suitable for critical analysis. Tabulated results as follows show 73 per cent five year cure rate in intrinsic lesions and 40 per cent five year cure rate of extrinsic lesions. For all cases five year cure rate is 55 per cent. The authors state if their 80 cases were classified according to surgical indications there are 72 cases which were either inoperable or suitable only for total laryngectomy when first seen.

Ten year end results of cases treated between the years 1931 to 1937 as follows: 38 cases, 5 indeterminate, 17 alive and well, or 51 per cent.

Total laryngectomy was performed in 9 roentgen irradiation failures and according to the surgeons performing the operations no special difficulty was encountered. Only 1 case was cured by this procedure.

Technical factors used included radiation quality of half-value layer 1.9 mm. Cu, 60 cm. focus-skin distance and tumor dose of 4,000 to 6,000 r achieved in thirty to forty days using three portals of entry.

The article ends with a discussion of prognostic points pertinent to carcinoma of the larynx with a statement by the authors that they will continue to employ roentgen therapy as the treatment of choice of all cases of carcinoma of the larynx with the exceptions discussed throughout the article.—*John H. Gilmore, M.D.*

SCHMITZ, HERBERT E. The treatment of cervix carcinoma with radium and 800 kilovolt x-ray. *Am. J. Obst. & Gynec.*, Feb., 1948, *55*, 262–272.

This article is an analysis of 166 cases of primary carcinoma of the cervix previously untreated. Seventy per cent of these cases were in the unfavorable groups (Group III or IV Schmitz classification). Microscopic grading of the tumors was carried out according to Broders' classification but this did not in any way influence the type of treatment which was subsequently given.

Radium and roentgen therapy were applied according to the following plan. The patient was measured by a special measuring frame which gives the exact outline of the pelvis. The depth of the tumor is determined by calipers and plotted in the pelvic outline. The number and size of the fields to be used are then determined. An attempt is made to deliver 4,000 r into the tumor-bearing area. Whenever possible, one anterior and one posterior field, 20×20 cm., is used. The irradiation factors are 800 kv., 10 ma. at 70 cm. focal skin distance; filter of 1 mm. of lead, 1.56 mm. of tin, 2.62 mm. of copper, 3 mm. of aluminum plus 2 mm. extension chamber. These factors give 44 r per minute on the skin. At 10 cm. the calculated depth dose is 56 per cent.

Patients treated in this manner experience intense discomfort over the bladder and rectum at the height of the irradiation effect, but there is little permanent injury from the radiation therapy.

Radium therapy is carried out in conjunction with roentgen therapy unless the condition of the cervix does not permit radium insertion into the cervical canal. Fifty milligrams of radium is placed in the cervical canal for thirty hours. This is repeated every seven days for a total dose of 4,500 mg-hr. Care is taken to irradiate the entire length of the cervical canal. If regression has not been satisfactory, further radium plaque therapy may be added at a later date.

Of the total series of patients treated by this method, 43 per cent lived five years and 28.9 per cent lived ten years. A previously reported group which was treated by lower voltage roentgen rays showed only 28 per cent five year survivals. This difference is due largely to the increased irradiation in the parametria which improves the results in Stage II, III, and IV. The results in Stage I are the same for both types of therapy.—*George W. Chamberlin, M.D.*

FREED, J. H., and PENDERGRASS, E. P. The diagnosis and treatment of primary ovarian carcinoma with special reference to radiation

therapy. *Cancer Research*, Aug., 1948, *8*, 361–370.

The authors review a series of 87 patients with a histopathological diagnosis of primary ovarian carcinoma, who received radiation therapy between 1930 and 1941. The age range was from below twenty years to over seventy years; however, 72 per cent were from forty to sixty-nine years of age. Forty-two per cent of the married women in this series had never been pregnant. The normal incidence of sterility is about 10 per cent. The possibility that congenital developmental anomaly may increase the chance for new growth is discussed.

It was noted that the most frequent presenting signs and symptoms were pain, abdominal swelling or mass, and either irregular menses or postmenopausal bleeding. It was also found that symptoms were usually present six months to a year before the patient consulted a physician. Ascites was found clinically or at operation in 39 per cent of the cases. Pleural effusion was noted at some time during the disease in about 10 per cent of the cases. The similarity of this pleural effusion to Meigs' syndrome is discussed.

It was found that neither the histopathological type nor the histopathological grade seemed to be of significance in treatment or prognosis. Of far more significance was the extent of the tumor at operation. A classification according to visible extent at operation is presented.

Treatment is discussed in detail. All patients had at least an exploratory procedure and, when possible, a hysterectomy with removal of both fallopian tubes and both ovaries. Because of the insidious onset, 75 per cent of the patients were not seen until the tumor had spread beyond the ovary. All patients received postoperative radiation therapy.

According to the authors, adequate surgery requires the removal of all ovarian tissue bilaterally; otherwise, the tumor may recur in the remaining ovarian tissue, in spite of postoperative irradiation.

The conclusions as to treatment of choice were as follows:

1. If the tumor is apparently limited to one ovary and can be completely removed, surgery alone is as efficient as surgery plus irradiation. Irradiation should be withheld until there is evidence of recurrence.

2. In all cases in which extension beyond the ovary is noted at surgery, postoperative irradiation is of definite value, both in the relief of symptoms and in prolonging life. It was found that if postoperative irradiation was begun before the fifteenth postoperative day, the patients did not respond nearly as well as when the treatments were postponed beyond fifteen days. The authors advocate beginning roentgen therapy six weeks postoperatively. A maximal tumor dose should be given whenever possible. The five year survival rate following tumor doses of 1,500 r or more was much higher than following doses of less than 1,500 r. The smaller doses control symptoms but do not prolong life.

3. Patients with far advanced, "inoperable" disease should be given the benefit of exploratory surgery with biopsy and thorough evacuation of abdominal fluid. Irradiation should then be given to the maximum tolerance level, followed by further surgery six to twelve weeks later to remove residual tumor tissue, if possible. Further irradiation may then be given, if indicated.

The authors report a five year survival rate of 39.2 per cent in this series.—*Karl F. Kesmodel, Jr., M.D.*

RADIOISOTOPES

Cronkite, Eugene P. Ionizing radiation injury; its diagnosis by physical examination and clinical laboratory procedures. *J.A.M.A.*, Feb. 5, 1949, *139*, 366–369.

Injuries produced by the new sources and radioactive materials—cyclotrons and their products, atomic energy industry, and atomic warfare—are the same as injuries produced by the old sources—roentgen rays and radium. Quantitatively, however, more persons are working with more potent materials. Prevention remains the first consideration and recognition of the injury is but secondary.

Data from animal experimentation supplement inadequate, and even absent, data from humans. The clinical and laboratory picture resulting from internal or external ionizing radiation is a function of the amount of radiation, its rate of delivery, and the depth dose.

The effect of single intense exposures (arbitrarily defined as total body exposure to more than 25 r delivered within a few hours) progresses in general as a direct function of the amount of radiation received. On the skin, the effect of radiation of low penetration, such as beta rays, is that of a thermal burn. Highly penetrating radiation, as from the atomic bomb, produces nausea and vomiting within a few hours. These subsided after a few hours

only to recur after a latent period inversely proportional to the amount of radiation received. Mucous or bloody diarrhea, purpura, epilation, and agranulocytic infections also appeared. With large amounts of radiation, in excess of 10,000 r, death may occur while the radiation is occurring. The prompt decrease in total lymphocyte count is most marked in twenty-four to seventy-two hours; moderate granulocytic leukocytosis develops at the same time. These tentative conclusions are drawn regarding a single intense exposure in man; if no decrease in the total lymphocyte count occurs in the first forty-eight hours, usually within the first twenty-four, the exposure has certainly been less than twenty-five r and symptoms probably will not appear. Between 25 and 100 r, a fleeting lymphocytopenia will develop and symptoms will probably be mild. Between 100 and 200 r lymphocytopenia will be of greater severity and duration; radiation illness and death will occasionally occur. Greater than 200 r, radiation illness will be much more severe and death will occur more frequently.

The insidious, progressive changes of repeated small exposures present an entirely different problem. At present 0.1 r is set as the maximum daily tolerance; and animal experiments suggest an even lower tolerance for females because of an increased incidence of ovarian tumors. Superficial changes include: increased brittleness and longitudinal ridging of the finger nails; cutaneous atrophy, pigmentation, ulceration, and carcinoma; epilation; impaired sensation at the finger tips; and radiation cataracts. However, alteration in the blood is the best biologic index of chronic total body overexposure. The diagnosis of chronic overexposure requires blood studies, perhaps differential counts of radiation in urine, feces, and nasal secretions, and, lastly, the elimination of other diseases and industrial hazards. This paragraph followed a tabulation of the fairly wide range in normal white cell counts, and emphasis on the need to rule out other diseases: "A partial review of the literature confirms the opinion that if any of the following alterations are noted in a person whose usual blood values are known and who has been exposed to ionizing radiation it is presumptive evidence of excessive exposure until proved otherwise: (a) a persistent depression of the total leukocyte count below 4,000 per cubic millimeter; (b) a persistent elevation of the total leukocyte count above 15,000 per cubic millimeter with absolute lymphocytosis; (c) relative lymphocytosis with a low total count (4,000 to 6,000 per cubic millimeter) that returns to base line range following removal from exposure; (d) an increased mean corpuscular volume (MCV), a shift in the Price-Jones curve to the right, an increase in the mean corpuscular diameter (MCD); (e) a reticulocyte count over 2 per cent; (f) erythrocytosis; (1) red blood count over 5,800,000 per cubic millimeter; (2) hemoglobin over 18.0 Gm. per hundred cubic centimeters of blood."—*Henry G. Moehring, M.D.*

MISCELLANEOUS

WYATT, GEORGE M. Barium sulfate in saline suspension. *Radiology*, Sept., 1948, *51*, 326–330.

The author advises the use of a mixture of a saline cathartic in combination with barium sulfate, both given orally, in two groups of patients, namely (1) those who cannot retain an enema because of a relaxed or damaged anal sphincter or perineum, (2) those who do not have clinical obstruction or dilation of the intestine but who present complete obstruction to the retrograde passage of a barium enema. The purpose of the combination is to prevent dehydration of the barium mixture and resultant impaction.

The method employed is as follows: (1) the patient is hospitalized; (2) 4 ounces of barium sulfate powder is mixed with 8 ounces of magnesium citrate (liquor magnesii citratis, *U. S. Pharmacopeia*, Vol. 13, p. 294). This mixture is given orally in the early morning and water is allowed ad lib. Another 8 ounces of magnesium citrate, without barium, is given one and a half hours later, and fluoroscopy is then done at intervals. Excretion is usually almost complete at the end of eighteen hours.

Three cases are reported with reproductions showing good demonstrations of lesions by this method.—*Chauncey N. Borman, M.D.*

WOLFF, J., and CHAIKOFF, I. L. Plasma inorganic iodide, a chemical regulator of normal thyroid function. *Endocrinology*, June, 1948, *42*, 468–471.

It has been known that the administration of large amounts of iodine temporarily inhibits the capacity of the normal thyroid to bind iodine organically. This inhibition appears to be related to the level of plasma iodine. To further test this, the authors injected large amounts of labeled iodine into nephrectomized rats. Up to

forty hours, practically none of the iodine had been converted into organic iodide even though it readily entered the gland. When much smaller amounts of iodine were injected into the nephrectomized rats the level of plasma iodine remained low enough to permit incorporation of nearly all the newly accumulated iodine into organic forms. This has definite significance in the iodine treatment of thyrotoxic patients with iodine.—*John W. Karr, M.D.*

Clark, Wm. G., Uncapher, Rex P., and Jordan, Mary L. Effect of flavonoids (vitamin P) on mortality from total body roentgen irradiation. *Science*, Dec. 3, 1948, *108*, 629–630.

The authors discuss previous experimental work with various flavonoids and their effect on the hemorrhagic syndrome following total body irradiation.

Healthy guinea pigs were fed a normal diet with added ascorbic acid. Half the group, in addition, received, in their drinking water, a 0.2 per cent of "calcium flavonoid," a water soluble extract from lemon peel, similar to rutin.

After a week of flavonoid supplementation, all were given 220–225 r total body irradiation, at 200 kv., using 0.5 mm. Cu and 1 mm. Al as filter.

Previous studies had shown an expected mortality rate, for 225 r, of 67 per cent, with 50 per cent mortality in thirteen days, and usual complete recovery from radiation injury in thirty days in the survivals.

The flavonoid treatment was continued for thirty days after irradiation.

In contrast to 67 per cent mortality from irradiation in untreated animals, only 35 per cent mortality was seen in flavonoid-treated ones, with all the hemorrhagic symptoms considerably less marked in the treated individuals.

The importance of this and similar inquiries into means of controlling the effects of total body irradiation cannot be overemphasized.—*William S. Wallace, M.D.*

Goldfeder, A., and Cameron, G. Growth in tissue culture of analogous mouse mammary carcinomas and their response to radiation. *Cancer Research*, Oct., 1948, *8*, 465–471.

The authors made a comparison of growth characteristics *in vitro* of two analogous mammary tumors in inbred strains of mice, C3H, and dba, and the response of these tumors to irradiation. It was found that although histopathologically similar, their reactions to irradiation differed. It was also found that when grown *in vitro*, they gave the reverse reactions to those when grown *in vivo*.

A dose of about 5,000 r would prevent proliferation of implants of dbrB tumor when grown *in vivo*, whereas a dose of 2,700 r was sufficient to produce the same effect on implants of C3H tissue.

In vitro the reverse was noted; a dose of 20,000 r produced significant changes in cells of dbrB tumor, whereas a dose of 100,000 r left the majority of cells of C3H tumor intact and apparently undamaged.

The tissue culture method reveals the intrinsic properties of cells unobscured by variable host reactions. It is incorrect to conclude from effects *in vivo* that a given tumor is or is not intrinsically radiosensitive, since the physiological characteristics of the host play so large a part in the behavior of the irradiated tumors.

It is concluded that certain intrinsic factors exist independent of histopathological structure, which govern the growth of a tumor and its response to irradiation.—*Karl F. Kesmodel, Jr., M.D.*

Dury, A., and Robin, E. D. Urethane-induced lymphopenia in normal and adrenalectomized rats. *Endocrinology*, April, 1948, *42*, 320–325.

This work was designed to test the suggestion that the adrenal is a part of the mechanism of urethane-induced lymphopenia. Their results show that there is a leukopenia and absolute lymphopenia in both normal intact and normal adrenalectomized rats when a 10 per cent urethane solution is injected intraperitoneally. Their evidence indicates that the adrenals are not involved in these changes in the blood picture. It appears that urethane behaves as a mitotic poison insofar as it affects the lymphocytes.—*John W. Karr, M.D.*

Elkeles, A. Angiocardiographic experiments on the pathogenesis of adrenalin pulmonary oedema in rabbits. *Brit. J. Radiol.*, Sept., 1948, *21*, 472–476.

When an intravenous dye for staining is injected into the ear vein of rabbits, 10–15 cc. of the dye is needed. When this injection is preceded by an injection of epinephrin, only 2 cc. is needed for the same degree of staining. This

observation led to an investigation of the blood flow with contrast media and roentgenography. In a normal rabbit the opaque medium is rapidly dispersed. After the epinephrin injection, the medium can be seen in the jugular veins, which are distended, and retrograde flow in the contralateral jugular and the peripheral tributaries of the head occurs. It was postulated that the epinephrin causes a temporary rise in pressure in the pulmonary circulation, and the path of least resistance is the veins of the opposite side of the neck.

The roentgenograms reveal the gross circulatory changes which are similar to those occurring in acute pulmonary edema of circulatory origin in humans. They explain the occurrence of pulmonary edema in rabbits after injection or aspiration of epinephrin.—*E. F. Lang, M.D.*

MAYNEORD, W. V. Développements récents dans les aspects physiques de la thérapeutique par les radiations. (Recent developments in physical aspects of radiation therapy.) *J. de radiol. et d'électrol.*, No. 9–10, 1948, *29*, 461–467.

This paper is a lecture given before French radiologists, November 19, 1947, and discusses: (1) the work done by the author and his colleagues in London since world war II on precise dosimetry by development of the dose contour projector and its application to three-dimensional radiation distribution, (2) collaboration of physician and physicist in present day medical research with the introduction of nuclear energy into the clinic and experimental medicine, (3) education of radiation therapists in physics, (4) courses of study offered by the author at the University of London. There the radiologist-in-training spends three half-days per week for a period of six months in the physics laboratory learning accuracy and attention to detail by making measurements of backscatter, dosage rate, depth dose, and utilizing the author's dose finder. (5) The routine organization and functioning of a medical physics department attached to the larger British cancer treatment hospitals is described.

The discussion of the author's dose contour projector is the most novel part of this paper. He is one of the foremost students of the subject of the distribution of radiation in the human body, a topic which still remains one of the central problems of radiation therapy. The apparatus enables one to determine the dose at any position in space for a beam of radiant energy inclined at any angle, assuming, of course, that the distribution in tissues is the same as in water. Excellent illustrations of this geometrical instrument are given. It is a rotary transparent plaque on which are inscribed isodose curves in such manner that a dose given to a specific point in the patient can be read on the transparent plaque at a glance before or during the treatment. The device gives a clear view of the distribution of the radiation in three dimensions and permits more accurate determination of the dose given any lesion whatever its location.

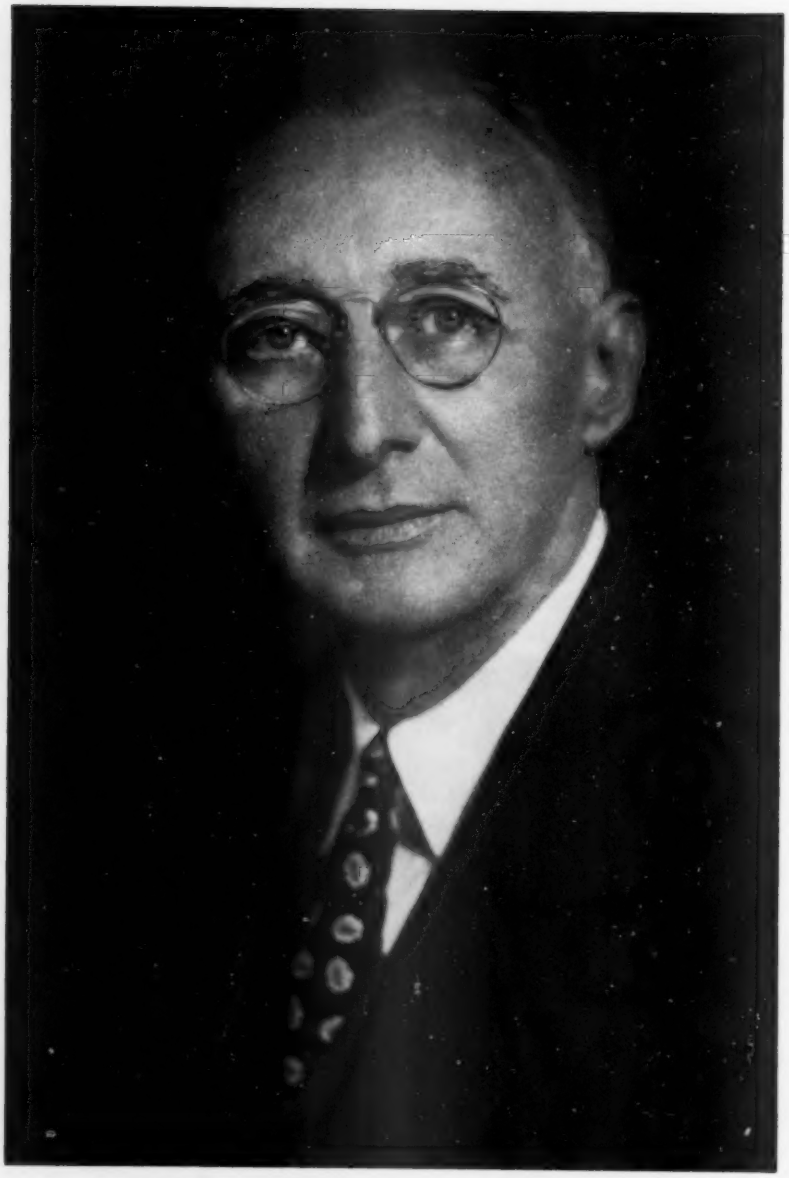
Now that "the Geiger-Müller counter has become the stethoscope of the radiation therapist" any article by Mayneord merits careful reading by every radiologist devoted to his specialty.—*William M. Loehr, M.D.*

COLTMAN, JOHN W. Fluoroscopic image brightening by electronic means. *Radiology*, Sept., 1948, *51*, 359–367.

To achieve fluorescent images at all comparable to roentgenograms, increases of 100 to 1,000 fold in the brightness of the fluoroscopic image must be attained. Roentgen-ray intensities are already at the patient's tolerance level and may not be further increased. Also, there is not sufficient energy in the emerging roentgen rays to form an adequately bright picture, even under ideal conditions.

Therefore, the problem must be solved by modifying the roentgen rays after they have left the patient. Image amplification has been achieved by converting the roentgen-ray pattern into an electron stream and accelerating these electrons to high velocities. In this way energy from an external source is introduced into the system and, when the electrons impinge on a phosphor layer, a brighter image results. This paper deals with the technical aspects of fluoroscopic image amplification, and describes in some detail the mechanism just outlined.

Coltman predicts the process will result in more advantageous use of the wafer grid; stereofluoroscopy; marked reduction in the time of examination, because of the immediate acquisition of the desired evidence; reduced roentgen-ray intensities; decreased necessity for dark adaptation; transmission and duplication of the image at different points for observation by several persons.—*Arthur A. Brewer, M.D.*



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